INTER AVIA

Review of World Aviation

In this Issue:

On the Death of Orville Wright

Reviewing the Latest Piston-Engined Fighters

Irish Civil Aviation — Light Amphibians

New Vistas in Sailplane Design — How Does Icing Affect Gas Turbines?

The Pellenc Report

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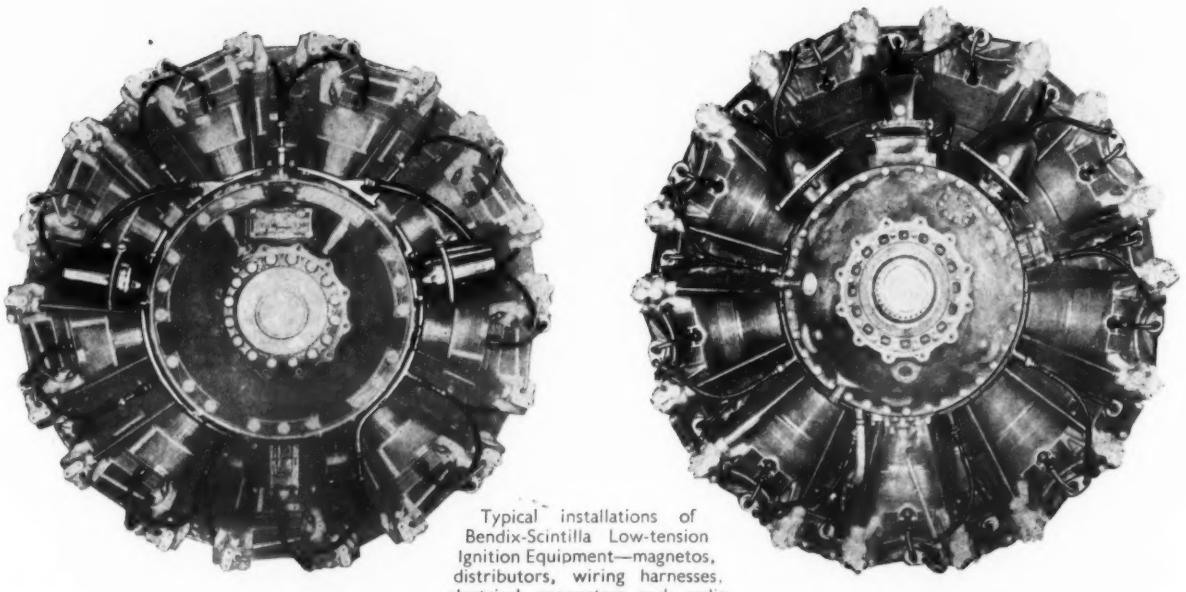

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New York at twilight, seen from a Luscombe 11-A Sedan.

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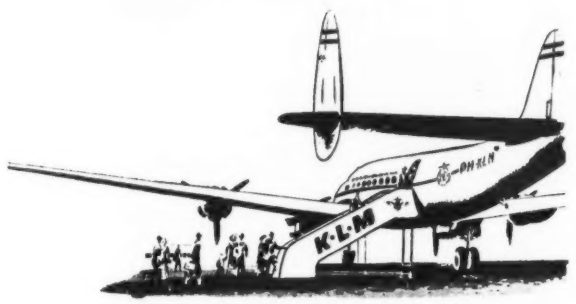

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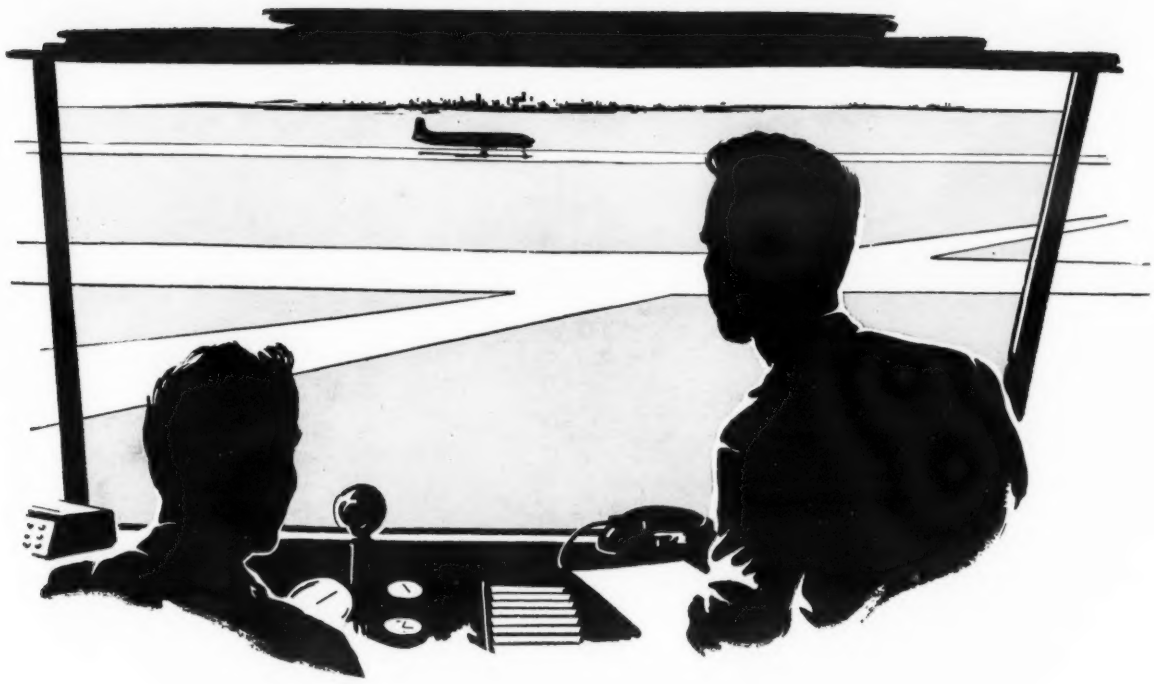

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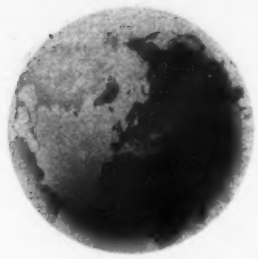


The Man from Toowomba

Discipline in Civil Aviation.

In Toowomba, Queensland, Australia, in 1911, a certain Bennett, Donald Clifford Tyndall Bennett, first saw the light of day. Of his youth we only know that he drank lots of milk. And as he is said still to abstain from the use of alcohol and tobacco it can be assumed that in this respect he has not abandoned the habits of his youthful days.

Young Bennett grew to manhood. In the early '30's he joined the Royal Air Force and changed over in 1936 to Imperial Airways. He became one of their best airline captains and navigators. In 1939 he joined the R. A. F. with the rank of Wing Commander, was given the command of a bomber unit and in April, 1942, he led a courageous and by no means unsuccessful raid on the German battleship "Tirpitz," which was at anchor in a Norwegian fjord. He was shot down but escaped to Sweden and later managed to get home ; and then his real rise began. He organised the Pathfinder Force of the R. A. F., a formation which had the task of pin-pointing German industrial targets with parachute flares, thus marking them for the night bombers following behind. The success of these operations is known to everyone, and Bennett terminated his service career as a much publicised Air Vice-Marshal.

The War was over and steps were being taken to reorganise civil aviation in Great Britain. As a former airline captain and navigator, subsequently a commander of bomber formations and chief of the Pathfinder fleet, Air Vice-Marshal Bennett was a flyer through and through and returned to commercial aviation. He was given the job of developing and running the British routes to South America, which up to that time had been neglected, and was appointed Chief-Executive of British South American Airways Corporation. He flew himself and he had others fly for him.

A few weeks ago it was openly said that Air Vice-Marshal Bennett, whose B. S. A. A. was the only one of the three British airline corporations to balance its accounts in the last fiscal year, might be promoted to a post of great importance and indirectly manage the whole of British civil aviation. On February 10th, however, the public learned that this same Bennett had been thanked for services rendered, awarded a gratuitous payment of £4,500, and dismissed from his post, thus severing his connection with aviation. What had happened ?

During the last two years we had occasion to come into contact with Air Vice-Marshal Bennett, once indirectly and the second time directly.

In 1946 we had a visit from a South American friend who had flown to Europe in one of the Bennett aeroplanes. Our friend began telling us things, and we opened our eyes and our ears.

On board the converted Lancaster bomber flown by B. S. S. A., conditions seem to have been—to put it mildly—somewhat Spartan. Accommodation was of a military nature, so to speak ; passengers and cargo were cheerfully mixed together. As bombers are not exactly soundproofed, the "Star Girl" stewardess—this modern feature of air travel was also on board—had to yell her perfunctory messages of comfort into the ears of the not very numerous passengers. Our friend related that there was even a spoon on board, but that this was the common property of all the occupants, including the crew. The whole atmosphere was rough, but cordial ; they were flying. Not strictly according to schedule, but you reached your destination—our friend was living proof.

Air Vice-Marshal Bennett had evidently first organised his airline in Pathfinder style. As aeroplanes were scarce at the time, and there were hardly any ships, you had to be glad that Bennett was flying. True, other American and European companies were flying the same route, but as they had proper airliners at their disposal they were sold out months ahead.

We are describing this now in order to show Bennett's mental affinities. He is a persevering and ruthless man who follows his path looking neither to the right nor left. At that time, however, we published nothing whatever regarding this air service, as we did not wish to give any trouble to Air Vice-Marshal Bennett, British civil aviation or commercial flying in general. We thought that things would get better.

Then fortune decreed that, in the autumn of 1947, we should enter into rather more direct contact with Bennett, the explorer of the South Atlantic.

In our newsletter, "Interavia Correspondence," of October 4th, 1947, the report appeared that the B. S. A. A. would introduce scheduled services with Avro "Tudor IV" four-engined commercial transports on its route from London to the Caribbean. The airline's first "Tudor IV" landed at Rio de Janeiro on October 1st from a proving flight with Air Vice-Marshal Bennett at the controls. The remark was added that although there were twenty-seven passengers on board, this airliner had not yet been granted a final certificate of airworthiness. As a matter of fact, words to the same effect appeared in the English daily papers. The head of our English editorial department, by no means a beginner and, in any case, an Englishman through and through, had checked and passed these reports—unfortunately for him !

Air Vice-Marshal Bennett took a personal view of the matter. Telegrams and telephone calls poured in from London. Bennett summoned our representative and our correspondents to his presence and threatened them with all the punishments of hell : The "Tudor IV" possessed a final certificate of airworthiness and unless the report was rectified instantly, unless an unqualified apology was tendered, etc., etc.

What could the English editorial department do ? Our Chief Editor was abroad and a refutation of Bennett's assertion could not be

obtained at a moment's notice. Perhaps Mr. Bennett was right. A rectification was made, together with expressions of regret.

Meanwhile, our editors, especially the English, are conscientious people. They wrote letters and they asked questions. On October 22nd A. V. Roe & Company answered one of these enquiries, saying that they were not quite certain as to the meaning of Air Vice-Marshal Bennett's expression—evidently when speaking to the press—"Final Certificate." On the other hand—and this was confirmed by a subsequent letter from A. V. Roe—the "Tudor IV" possessed a full certificate of airworthiness. Perhaps we asked rather a lot of questions at the time, and we now apologise for our inquisitiveness. Finally, it had to be admitted that, while the "Tudor IV" possessed a full certificate for commercial operations, there was none the less a slight blemish : before the first passenger flight the restriction still existed for this type that it had not yet been tested and accepted under icing conditions. Whether this has taken place in the meanwhile, we are not in a position to say.

The case of the "Tudor IV," the case of Air Vice-Marshal Bennett, the report and its rectification were laid to rest in the pigeon holes of our news room. We had other things to do.

On the morning of January 30th, 1948, something happened which ought not to happen in civil aviation. We regretted it no less than all those who have faith in air transport.

That morning the "Star Tiger," one of B. S. A. A.'s three "Tudor IV' s" with full or final certificates, disappeared without sound or trace over the Atlantic between the Azores and Bermuda. According to the first reports the aircraft carried sixteen passengers and a crew of six. Later accounts said that there were as many as twenty-five passengers, among them Air Marshal Sir Arthur Coningham, one of the most successful of British Air Force officers. The fact of this accident, the investigation which had been begun, and respect for the dead seemed at first to compel us not to go further into the matter.

It needed Air Vice-Marshal Bennett himself to make us alter our attitude.

Let us briefly reconstruct the affair as it appears up to now.

A four-engined long-range aeroplane with a full certificate of airworthiness, experienced crew, pressurised cabin, etc., took off from the Azores and sent out her last radio message from a point about 600 miles from the nearest airport of destination, Bermuda, stating that everything on board was in order. The message is also said to have stated that the aeroplane was about 2,000 ft. above the sea, which, in view of the over-water stage and the considerable distance from its destination, is not quite customary. But perhaps weather conditions dictated this low flying altitude. After this message there was silence and the aeroplane became overdue.

How can such a thing happen ?

Was the entire radio equipment destroyed by some freak of the weather, lightning, or something of the kind ? Did the aeroplane touch the water owing to some mistake in piloting, and sink ? Did all four engines stop simultaneously and very suddenly ? Did something break in the air ? Was the aeroplane a victim of sudden icing ? We do not know, but, at any rate in theory, we cannot think of any other possibility which could cause the loss of a multi-engined aircraft on a regularly-flown route without the crew having at least the time to send out an S. O. S. There are no living witnesses and, up to the present time of writing, no trace of the aeroplane has been discovered.

Then the British Ministry of Civil Aviation took the step which every responsible aviation authority in the world would have done in the same circumstances. On February 3rd, 1948, it grounded B. S. A. A.'s two remaining "Tudor IV's" as a precautionary measure pending clarification of the accident.

Expert and interested M. P.'s had already asked in the House of Commons on February 2nd whether proving flights had been carried out over this route with the "Tudor IV" before passengers were carried, and whether the Minister had satisfied himself that the aeroplane carried fuel in case of emergency to reach another base. Mr. Lindgren, Parliamentary Secretary to the Ministry of Civil Aviation, gave to understand by his answer that these two questions constituted one of the chief subjects of the investigation.

But Air Vice-Marshal Bennett, for his part, did something which not every airline company director would have done under the circumstances. He stood up and gave the representative of the "Daily Express" an interview in which he said :

"I contest Lord Nathan's grounding of the 'Tudor IV'. This airliner... has in fact been thoroughly tested in every conceivable way. ... Training of crews handling the 'Tudor IV' has been meticulously executed, and the crews have been checked. The Minister of Civil Aviation... found it necessary to interfere with what I took to be a matter for my own decision..."

We can only say that Air Vice-Marshal Bennett, in expressing himself in this manner, seems to have changed his rôle of airline manager for that of a bomber commander in wartime.

The gentleman from Toowomba used more or less the same tactics with the Ministry of Civil Aviation that he employed against us : *L'Etat c'est moi*—your job is to hold your tongue.

In wartime Bennett had every right to send aeroplanes into action on his own responsibility, to wherever the strategic position made it necessary. In peacetime commercial flying, however, he has to abide by the maxim of "Safety first," and it is not for him to decide whether an airliner is airworthy, but for the authorities to whom he reports. The people who fly with airline manager Bennett are not soldiers who have to give their lives for their country, but paying passengers who want to reach their destination alive.

In our opinion, Air Vice-Marshal Bennett, brilliant officer though he was, as an airline manager has given his colleagues a bad example. The statements made during his interview with the press were contrary to the most elementary principles of discipline.

What does the Bennett case demonstrate ?

After being eliminated from the management of British South American Airways he addressed undergraduates at Oxford.

"I warn you," he said, "never be successful : you will suffer enormously." Fundamentally, this is nothing but an expression of wounded vanity.

Would you like to know the cause of the Air Vice-Marshal and airline manager's failure ? A little story is being told in London. A man went to Heaven and St. Peter asked him who he was. The candidate for celestial bliss stated that he had been a well-known psychiatrist on earth. St. Peter said, "Come here quickly. Napoleon has gone crazy and thinks he's Air Vice-Marshal Bennett."

There you have the man from Toowomba. *EEH.*

* *
*

On the Death of Orville Wright

On 30th January, 1948, *Orville Wright* died at his home town of Dayton in the U. S. State of Ohio. In the Anglo-Saxon world, and in a great part of Europe too, he is considered, together with his brother Wilbur, to have been the inventor of the aeroplane, the father of present-day aviation.

As a young man Orville Wright must have looked Death in the face often enough. But Death comes in his own time and Orville was seventy-six years old when he died of pneumonia in a hospital at Dayton, where the great Air Force base is named after him—Wright Field. His elder brother, Wilbur, died of typhus as long ago as 1912.

The question is often asked whether the Wright Brothers were really the inventors of

Orville Wright in 1903.

the aeroplane. There are Frenchmen, Germans, Britons and other nationals who claim to have invented the heavier-than-air aircraft. In reality the aeroplane is a product of collective work, although but few members of this collectivism, this circle of inventors, knew each other personally; and some had but the vaguest ideas of the others' activities.

However this may be, Orville Wright is undoubtedly a leading figure in aeronautical history.

He was the first to take off with a power-driven heavier-than-air aircraft and to succeed in landing it undamaged. He was the first to fly a curve. He was the first to remain airborne for more than an hour in such a machine. He was the discoverer of certain aerodynamic laws and he constructed one of the first wind tunnels.

A great achievement, it must be agreed.

There was a great difference between him and most of his successful fellow-countrymen, between him and most of the first aviators. He hated propaganda, he hated popular success, and to him the press was like a red rag to a bull. He was vastly unpopular with his contemporaries.

Really he was a remarkable fanatic. Long before the first war, when money had some value, he declined an offer of 600,000 French francs, in gold, offered him for an aeroplane at the instigation of the French Goverment, on the ground that this sum was insultingly small. And he was not a rich man.

Another of his pioneer acts was tragic but involved him in no blame. On 17th September, 1908, he suffered the first aeroplane accident which caused the death of a passenger. The latter was Lieutenant Thomas E. Selfridge of the American Army Signal Corps. At a height of about 100 feet an airscrew blade fouled a cable and broke, causing the aeroplane to crash. Selfridge died the same evening and Orville Wright sustained severe injuries, which were the greatest handicap to him in his subsequent flying career.

* * *

The development of the Wrights' invention, the technical details of their first aeroplane,

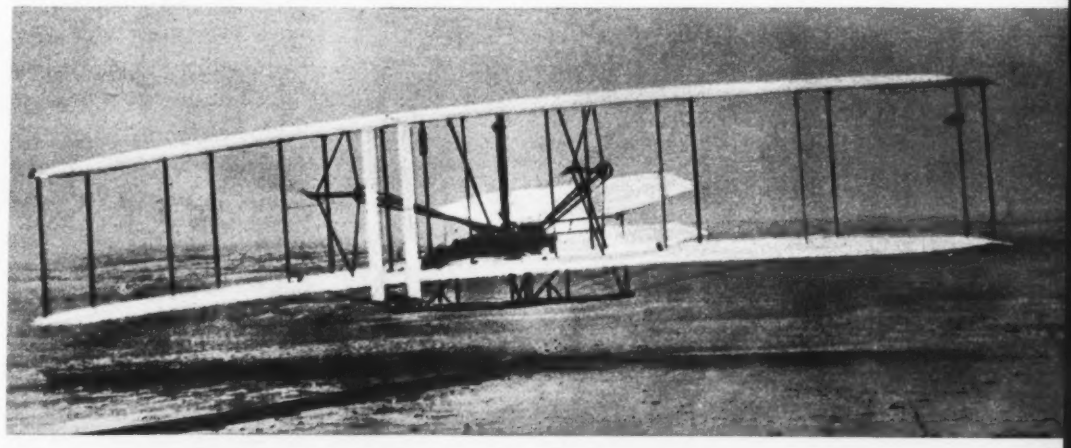
Orville Wright in his later years.

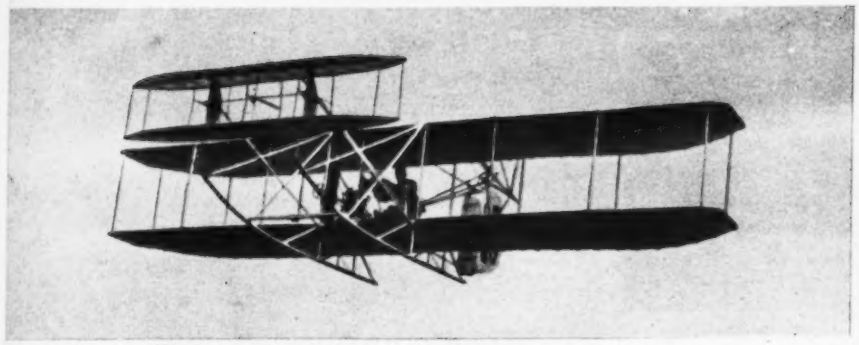
the brothers' practice camp at Kitty Hawk Hill in Northern Carolina and their first flights on 17th December, 1903, are all history today.

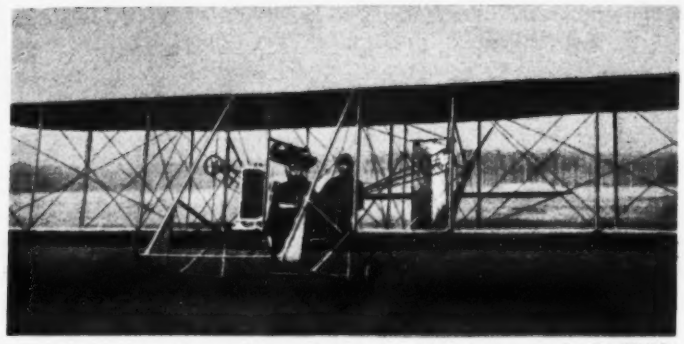
There will probably never be agreement as to whether the Wright Brothers or their European contemporaries had more influence on the origin of aviation. National pride plays an important part in this question.

There is no proof to the allegation that some parts of the first Wright aeroplane were copied from certain European originals. It is known that Orville and Wilbur had a great admir-

17th December, 1903: Orville Wright's first flight.







Wright aeroplanes were found in all European countries during the pioneer days. Eugène Lefebvre on the left and Abramovitch on the right, at the controls of a Wright aeroplane constructed in Germany in 1912.

ation for Lilienthal—they had a German grandfather—took him as their example and exchanged ideas freely with his pupils. One of the chief of these was the French-born

Ferdinand Ferber, a captain in the French artillery, and one of the most energetic pioneers of French aviation, advised the French War Ministry to buy a Wright aeroplane.

American engineer, Octave Chanute. It cannot be denied that the American physicist, Professor S. P. Langley, brought back many things worth knowing to Kitty Hawk after his European trip and his visit to Clément Ader, another Frenchman, in 1899. But this does not justify calling the Wrights plagiarists or patent thieves.

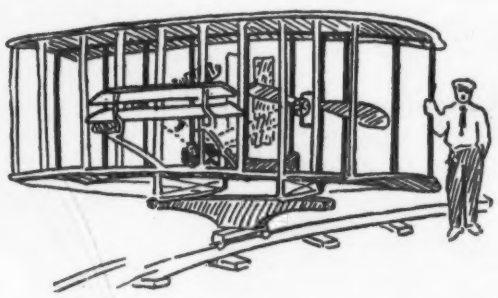
Following in Lilienthal's footsteps they accurately constructed a strut-braced biplane, reminiscent of that of Chanute but not of Ader's ornithopter. Ader used a steam engine, having nothing else available, but the Wrights built a combustion engine, remarkable for its small specific weight of 240 lbs. to 12 H. P. Every part of the aeroplane is still today a dumb witness to their creative talent. The chain drive of the two airscrews cannot but recall their place of origin—the bicycle factory where the Brothers earned their living and built their aeroplane.

Despite what many Europeans say it is not too much to assert that the Wrights did not merely draw inspiration from Europe but that they also had much to offer Europe.

* * *

While Orville and Wilbur Wright were busy in their Dayton workshop making the first wind tunnel out of an old wooden box and testing hundreds of models in it, and while they were putting together their fabric covers on a neighbour's sewing machine, the first aircraft constructors in Europe were at work. France was the most fruitful soil and one of the most persevering designers was Ferdinand Ferber, an artillery captain. He was one of the first victims of the air age, for he had a fatal accident with a Voisin biplane in 1909.

The drawing of the Wright aeroplane brough back to Paris by a French editor named Coquelle and published on 24th December, 1905, in "L'Auto."



A session of the American National Advisory Committee for Aeronautics (1939): third from the left (sitting), Orville Wright; seated on his left, Lindbergh.

Just after the beginning of the century Ferber was leaving nothing untried to secure his own country's leadership in aviation. In his thoughts he jealously watched the progress made by the Wright Brothers. Following their first successful attempts at Kitty Hawk, in December, 1903, he made them an offer in writing to purchase their aeroplane; an offer which, one may tentatively assume, was backed by the French Government. The Wrights delayed their answer for over a year, but Ferber persisted. He had to know what a Wright aeroplane really looked like. One of the editors of the sports paper "L'Auto," a man named Coquelle, went to Dayton; and in the news room of the "Dayton Daily News" got possession of the block of a drawing, the publication of which the Wrights had hitherto prevented. On 24th December, 1905, this drawing appeared in "L'Auto" and another on 7th February, 1906.

Ferber afterwards wrote that this drawing had been of vital importance to French aeroplane construction. Hitherto unknown details had been learned, among others the box control used by Farman in 1907. Recommending the French War Ministry to buy a Wright biplane, Ferber explained: he, Ferber, was near solving the problem and regretted that he had no available means for installing suitable engines in his aeroplanes. He believed, however, that the French Government had the means to make rapid use of the Wright brothers' invention and hoped, therefore, that an aeroplane would be bought in Dayton, copied and improved.

* * *

Is not that collectivism? Men like Lilienthal and Ader were working in Germany and France, and John Stringfellow in England, all at about the same period. They worked separately, but jointly they laid the foundation of the aviation which characterises our present era.

We will not be so foolhardy as to answer with a single name the question as to who invented the aeroplane. But like Icarus, Leonardo da Vinci, and their successors, the name of Orville Wright will remain imperishable in the history of our new age.

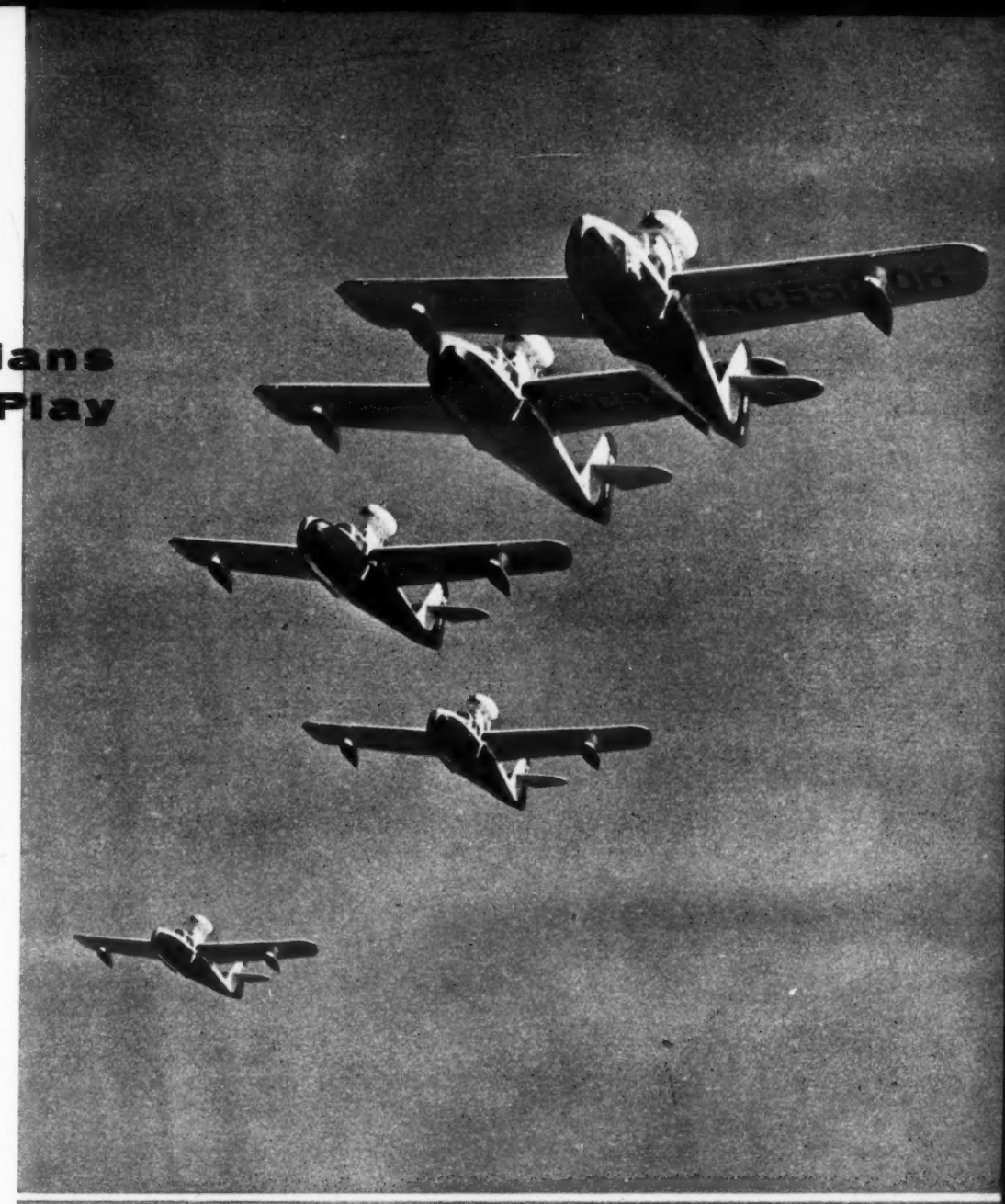
Light Amphibians for Work and Play

If you are of the outdoor type, haven't you ever watched wild duck, wild geese and other birds of passage—how they manage to swim better than they can walk, fly so strongly and swiftly that they can migrate thousands of miles with each change of season ? And seeing them lightheartedly fleeing from autumn mists, haven't you ever yearned to fly away too, and also enjoy the clear blue skies and warm shores of sunnier climes, even if only for a few days ?

But there is never a day that you don't see attractive advertisements in travel agencies and magazines, depicting just the change of scenery you need. Moreover, airline companies are always glad to hand you timetables showing how to get there quickly, safely and comfortably. And yet you don't truly respond to all this luxury. Travelling according to timetable doesn't quite appeal to you—at least not when you're on a holiday. It's too reminiscent of the office routine you want to get away from.

This idea of ruling time and space has bitten engineers as well. In our grandfather's day Jules Verne, the prophet of modern technical development, described a universal conveyance, able to fly, float, drive and dive. Since then the prophet's disciples have been striving to realise this idea and to develop an all-round, or at least fairly versatile, means of transport.

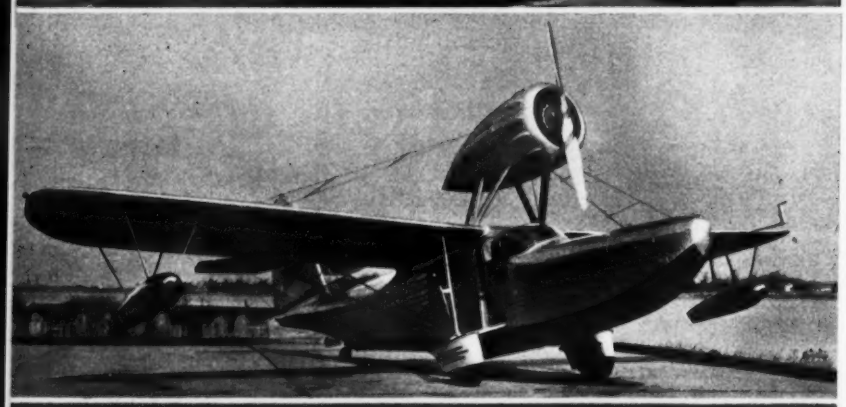
Today there are many aircraft capable of flying and floating and taxiing on land. Amphibians are just as much at home on the runways of up-to-date airports as on primitive emergency landing fields, or on lakes, rivers and bays. But although the idea of the amphibian is in itself obvious and simple, and the first practical designs came out more than fifteen years ago, it is only recently that this type of aeroplane has gained fairly widespread popularity. Amphibians were always relatively



A happy flock of "Ducks" and a lonely bird of passage. (Goodyear "Duck" and Grumman "Widgeon.")

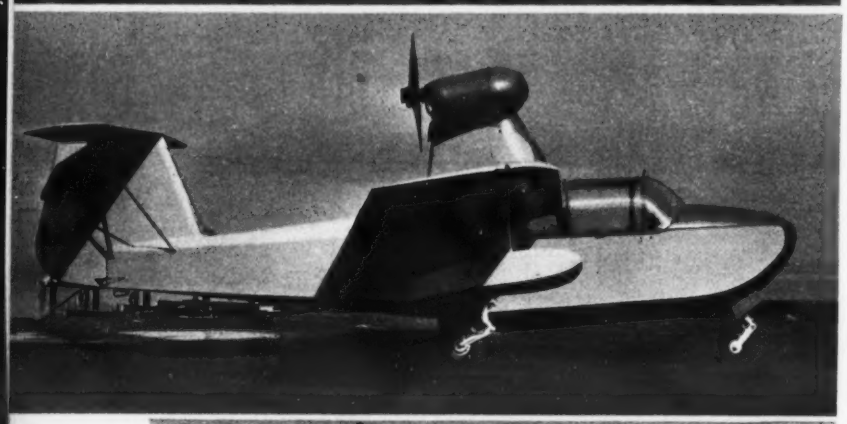
Fifteen Years of Amphibian Flying History

Starting with the Dornier "Libelle" 1932)...

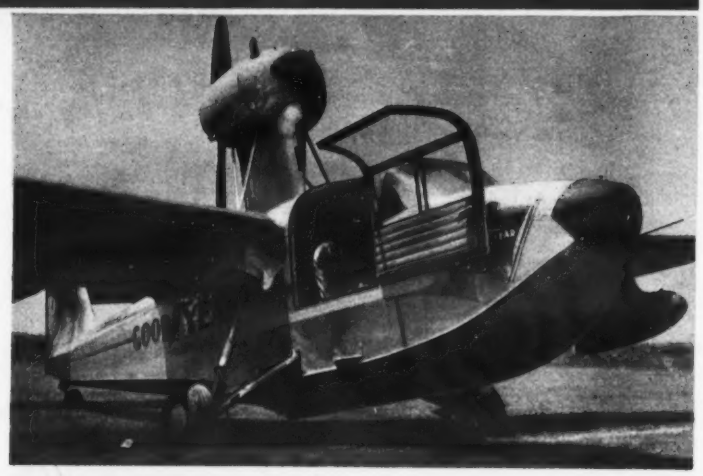


...we come via the Fleetwings "Sea bird" (1937)...

...to the Republic "Seabee" (1945),



the Bunyard "Sportsman" (1946)



and the Goodyear "Duck" (1947) with cross-wind landing gear;

expensive, and landplanes, being faster and more comfortable, easily surpassed them.

Romantic prospects should not tempt one, however, to regard amphibians as mere toy aeroplanes for sportsmen flyers. That would make them too expensive to run, like a motor-car which its owner only takes out of the garage on Sunday, for a trip into the country, while he takes the bus or the train for going to the office. Amphibians should be used in the first place for travelling, and made to pay at least part of their way by it; at the same time the possibilities they may offer for week-end pleasure trips, or combining business journeys with bathing, fishing or hunting, are a most welcome factor in their favour.

The possibility of temporarily interrupting a flight on the nearest suitable expanse of water gives the occupant an additional sense of protection against the usual tricks of weather and climate. Gone are the well-known psychological inhibitions which more often than not make the pilot of a light plane look attentively at his instruments and the approaching shore when crossing stretches of sea or large lakes. Furthermore, if the worst comes to the worst, it is possible to make an emergency landing on the ground with retracted undercarriage, as the hull bottoms of amphibians are of sufficiently rugged construction.

In order to highlight the design principles and progress achieved in the field of amphibious aircraft construction, the paragraphs which follow will delve into history a little, though confining themselves to light amphibians for business and pleasure flying. Heavier designs like the Grumman "Mallard," Short "Sealand" and the earlier prototypes built by Douglas, Fairchild, Macchi and Sikorsky, which would have to be called transport amphibians, or at any rate feeders, remain outside the scope of this article. Meanwhile, however, only these large amphibians can be referred to as being completely seaworthy. The lighter types can only cope with limited amounts of rough water. Real mill-pond conditions must prevail if a take-off is to be made safely at any great distance from the coast, and this also goes for landings and long taxiing stretches on the open sea. However, the restricted seaworthiness characteristics of light amphibians need not present any problem, since it is invariably possible to find suitably sheltered coastal waters, lakes or wide rivers from which to operate.

Amphibians can be divided into two families, according to the number of engines they have. Both families take their origin in the basic 1932 types: the Dornier "Libelle" (single-engined) and the Saunders-Roe "Cutty Sark" (twin-engined). In them can be recognised many design principles that are common to both flying-boats and amphibians. Typical of the hull are the wave-breaking bow, the low step aft of the centre of gravity, and

the concave, wave-binding form of the hull bottom. So that the hull cannot be flooded by a single leak it is divided by bulkheads into separate watertight compartments. The high-set wing has stabilising wing-tip floats to prevent the tips from dipping into the water in the event of a strong cross-wind. The tail assembly is also set as high as possible. Non-corrosive materials should be used for all metal parts : stainless steel for the undercarriage struts, for instance, and hydronalium or metallic protective skins for the hull portion. Magnesium alloys are off the list. These lines have been followed in all modern types of amphibian, though designs differ considerably with regard to the position and configuration of the power plant, undercarriage, cabin and entrance facilities.

As regards power plant installation, some amphibions have nacelles mounted directly on the wing (Grumman amphibians and Commonwealth "Trimmer") or a little above it (Republic "Seabee"), while in others the engine nacelle is aerodynamically separated from the rest of the aircraft. The airscrews must be some way above the water so as not to catch flying spray. The engines must be easily accessible from the hull or wing—in single-engined amphibians it can usually be serviced quite conveniently from the top of the hull, while in twin-engined models the wing portion between the nacelles is usually sufficiently reinforced for walking on. That single-engined models are best provided with a pusher airscrew to permit direct access to the cabin is illustrated by opposite configuration featured by the Fleetwings "Sea Bird," which proved unsatisfactory in this respect. Twin-engined types, on the other hand, usually have tractor airscrews, in view of the spray. The strong nose-heavy moment of the airscrew thrust about the centre of gravity of the aeroplane can be compensated by a slight positive adjustment of the engine axis. This is because the slipstream of the airscrew, with up to about double dynamic pressure within the slipstream zone, has an increasingly tail-heavy effect on the elevator when the throttle is opened. This positive engine adjustment is clearly discernible in some of the accompanying illustrations. Reversible-pitch airscrews are also very useful for shortening the landing run on water, as is proved by the "Seabee." A water rudder is usually fitted to increase manoeuvrability on the water.

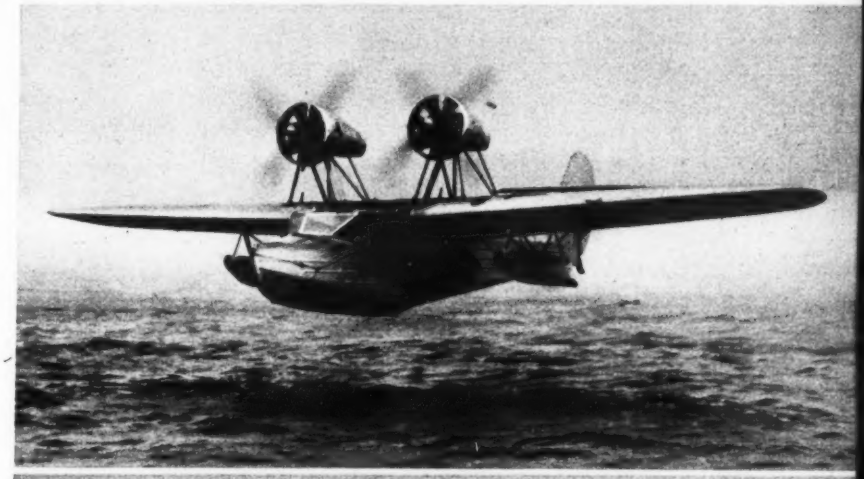
The undercarriage is fully retractable in high-class amphibians, and in any case it must of course be possible to lift it clear of the water. It is most important that the aircraft should be able to taxi under the power of its own engines from the water to the land and, vice-versa, creep like a reptile into the water again. This can naturally only be expected where the shore slopes gently or special ramps have been constructed. Moreover, it is an appreciable advantage, though not indispensable, if the undercarriage can be lowered by pressure so as to lift the entire aircraft, even when the keel is already on the ground.

Both the cabin and the entrance configuration have caused designers a certain amount of headaches, especially in cases when tractor airscrews are fitted. The entrance must not only be protected from flying spray but, in particular, be as safe and convenient as possible. The entrance hatch at the top of the boat, featured by most twin-engined types, is a typical stop-gap solution. The designers of the Republic "Seabee" and the Goodyear "Duck" have both found excellent solutions to this problem. Then, the "Seabee" and the two-seater version of the "Duck" have a very roomy luggage hold. This is a praiseworthy feature, for even the least exigent of sportsmen flyers wants to take something more with him than his toothbrush. The designer should therefore not only think of stowage facilities for luggage, but also for boating equipment, as well as such items as collapsible canoes or rubber boats, and so forth.

Constructional and performance data, and prices of the aeroplanes under discussion, are given in the table overleaf. In the course of development, engine output, all-up weights, and mostly the seating capacity, too, have increased more than was thought possible when the first designs evolved, probably because the structural weight was originally underestimated. In their final form, however, all types show remarkable agreement as to their figures relative to wing- and power-loading, and according to their aerodynamic qualities ; and also as regards flight performance data.

Future designs will not easily be able to surpass the early models, either from the engineering or the economic points of view. But even from a light amphibian we already demand that it should be clean and easy to manage, as soundproof as possible, and that we can wear everyday clothes without looking like factory hands when we have finished a flight.

If we depart from the three- and four-seater designs and build two-seater amphibians, engines of 100 H.P. or slightly less will be quite adequate. Such aeroplanes would be particularly welcome in Europe, not only because of the low purchase price but also because the high price of aviation fuel unfortunately prevailing in Europe has a marked effect on the operating cost. These light amphibians should have folding wings in



and the Saunders-Roe "Cutty Sark" (1932). . .

. . . and the Hopfner HA 11 (1933)

. . . lead us to the Grumman "Widgeon" (1940)

order to keep down storage cost and also, if necessary, to facilitate transport by road. Presumably the construction of small two-seater amphibians would open a wider market for this type of aircraft in Europe. The numerous lakes, the Scandinavian fjords and the Mediterranean shores certainly make the prospect inviting.

Those toying with the idea of buying an amphibian will have to make up a very detailed budget, for which purpose the following figures will be useful. The cheapest single-engined amphibian at present obtainable, the four-seater Republic "Seabee" with a 215-H.P. Franklin engine, still costs the handsome sum of about $6,000 ex-works. For outside the U.S.A. it might be necessary to add the cost of sea transport and re-assembly. The Goodyear "Duck," for which a price bracket of $5,000 is given, is unfortunately not yet available to the private purchaser. Apart from the purchase price the operating cost has to be considered and a budget made up for fuel, oil, insurance, hangar rent, maintenance, minor repairs and also, unfortunately, for the inevitable take-off and landing fees. If one hundred hours are flown a year, the operating cost in Europe amounts, without writing off depreciation, to at least fifty Swiss francs per flying hour, which is equivalent to about twelve dollars. (In the U.S.A. this would only be about ten dollars, owing to the cheaper price of fuel, though maintenance and insurance costs are higher.) Budgeting per month, this runs up to between 400 and 500 Swiss francs, even without writing off the usual depreciation. The operating costs and the depreciation for the Goodyear "Duck" are probably both twenty per cent. lower.

Considerably higher expenditure is involved in the purchase and upkeep of twin-engined, four- to five-seater amphibians like the Grumman "Widgeon." This luxury waterfowl cruises at 120 to 142 m.p.h. at sea level, climbs at the fast rate of 1,000 feet a minute, and features a high degree of safety, in view of its good performance qualities on one engine. But the purchase price of about $30,000 for a new "Widgeon," allowing for complete depreciation within five years, boosts the monthly expenditure to dizzy levels. Only if the aeroplane is used extensively can a justifiable cost per flying hour and per aircraft-mile be obtained. If we take twenty flying hours a month, that is about 2,500 aircraft-miles, as the lowest economic limit, the outlay per person per aircraft-mile approaches the fares imposed today by scheduled airline companies. And this is only under the condition that the "Widgeon" always carries five occupants.

If anyone today expresses his intention of buying an amphibian he must expect to be discouraged on all sides. "Every combination is a compromise," his friends will tell him, "and therefore inferior to the direct solution to the problem. Landplanes are faster than amphibians, climb better, carry more load etc." These objections do not hold good, however, because the advantages of the amphibian are contained precisely by its versatility. A cruising speed of 100 to 130 m.p.h. is usually enough, since ordinary small landplanes of the same class seldom exceed these figures. If an amphibian is adequately powered, its general performance does not compare at all badly with that of conventional land or seaplanes.

Before the new owner of an amphibian ventures on the water he will do well to acquaint himself with his boating equipment, notably the various devices for mooring and towing. He must know how to handle a painter rope and be able to tie sailors' knots. On the water everything must be shipshape, and this applies to amphibians just as much as to seaplanes. So knowledge of aviation is not enough ; the pilot must also be a bit of a sailor and be able to prove this to the authorities in order to get his licence. The tests for amphibian ratings include not only water take-offs and spot landings, but manoeuvring and mooring on the water. However, all this can be mastered after a few hours of practice. The take-off on water is rather longer than on land, but it is not difficult with amphibians and there is usually plenty of space. Whereas seaplanes are exposed to the risk of capsizing if there is a strong cross wind blowing, wind direction has not so much effect on flying-boats and amphibians since the wing is set lower and has stabilising tip floats. Attention must be paid, however, to the direction of the waves and to ground swell. As the pilot is sitting comparatively deep he can get a good idea of the water surface. It goes without saying that he must look out for floating logs, though small bits of wood do not do much harm.

Unfortunately the amphibian can no more escape from police regulations than the landplane. On the contrary, prospective owners of amphibians will be sorry to learn that this

Year	Make	Seats	Structure	Power plant			Dimensions		Weights		Loadings		Speeds			Climb		Range	Costs	
				Number	Engine and airscrew	Rated power	Span	Wing area	Tare	Gross	Wing	Power	Max.	Cruise	Land.	Rate (sea level)	Service ceiling		Price ex-works in dollars	Consumption in U.S. galls./hr.
						H. P.	ft.	sq. ft.	lbs.	lbs.	lb./sq. ft.	lb./H. P.	m.p.h.	m.p.h.	m.p.h.	ft./sec.	ft.	miles		
1932	Dornier "Libelle"	3	Metal/fabric cantilever	1	Gnome & Rhône "Titan 5 Ke" pusher	300	42.6	300	2370	3080	10.3	10.3	130	110	50	15	16,500	350	—	16
1937	Fleetwings "Sea Bird"	4	Steel/fabric wire-braced	1	Jacobs L5 tractor	300	40.5	235	2500	3800	16.2	12.7	150	130	60 flaps	15	15,000	400 550	18,500	17
1945	Republic "Seabee"	4	Metal strut-braced	1	Franklin 6A8 reversible pusher	215	37.6	196	1950	3000	15.3	14	120	105	55 flaps	11.5	12,000	350 550	6,000	13
1946	Bunyard "Sportsman"	4	Wood cantilever	1	Continental E185 2-pitch pusher	185	34.3	187	1700	2750	14.7	14.9	135	120	55 flaps	10	9,500	550	8,500	12
1947	Goodyear "Duck"	3	Metal/fabric cantilever	1	Franklin 6A4 c. p. pusher	145	36	179	1450	2200	12.3	15.2	125	110	55	11	11,000	375	5,000	9
1932	Saunders-Roe "Cutty Sark"	4	Composite cantilever	2	"Gipsy Major" or A.S. "Genet" pusher	260	45	320	2700	3850	12	14.8	105	90	55	8	9,000	325	20,000 *	16
1933	Hopfner HA 11	4	Wood cantilever	2	Siemens Sh14a pusher	320	46	323	3100	4650	14.4	14.5	125	105	60	8	10,500	375	12,500 *	21
1940	Grumman "Widgeon"	5	Metal/fabric cantilever	2	Ranger 6-440-C pusher	400	40	245	3240	4525	18.5	11.3	160	130	60 flaps	16.5	15,000	775	30,600	20
1944	Commonwealth "Trimmer"	3	Wood cantilever	2	Continental C85 c. p. pusher	170	35.5	162	1520	2200	13.6	12.9	135	115	50 flaps	14	14,000	450	6,000	10

Note : Prices stated are price brackets, ex-works. Those marked with an asterisk are prewar prices at the current rate of exchange.

latest means of transport is subject to even more restrictions than any other aircraft type. As it is at the same time fish and bird, the responsible authorities keep to the safe side and impose as many prohibitions as possible. The freedom of the air which the "amphibious pilot" would so much like to find is particularly rare in densely-populated areas. Picturesque lake districts have usually been discovered by other people already, unless they lie in the middle of virgin forest, and it may be that a landing permit is only obtainable once the local police authorities have cleared the desired water surface at a fixed time and, of course, at the expense of the poor pilot.

Of course the authorities have a certain amount of right on their side when they try to protect the freedom-loving amphibian pilot from the possible consequences of his enterprising spirit. Furthermore, the curiosity and ignorance of non-flyers is not only a nuisance but sometimes a danger, too. Rowing boats and bathers often cause serious accidents at the take-off or the landing, and every owner of an amphibian has experienced the inquisitiveness of those who want to inspect his aeroplane when it is lying at its moorings.

Meanwhile, however, once amphibious aircraft have come into general use and their owners have realised that the fact that they are not bound to official airfields does not justify their disregarding the rules of the air, the authorities will possibly slacken the reins. After all, the traffic police do not compel cyclists to get off when cars are passing through the street.

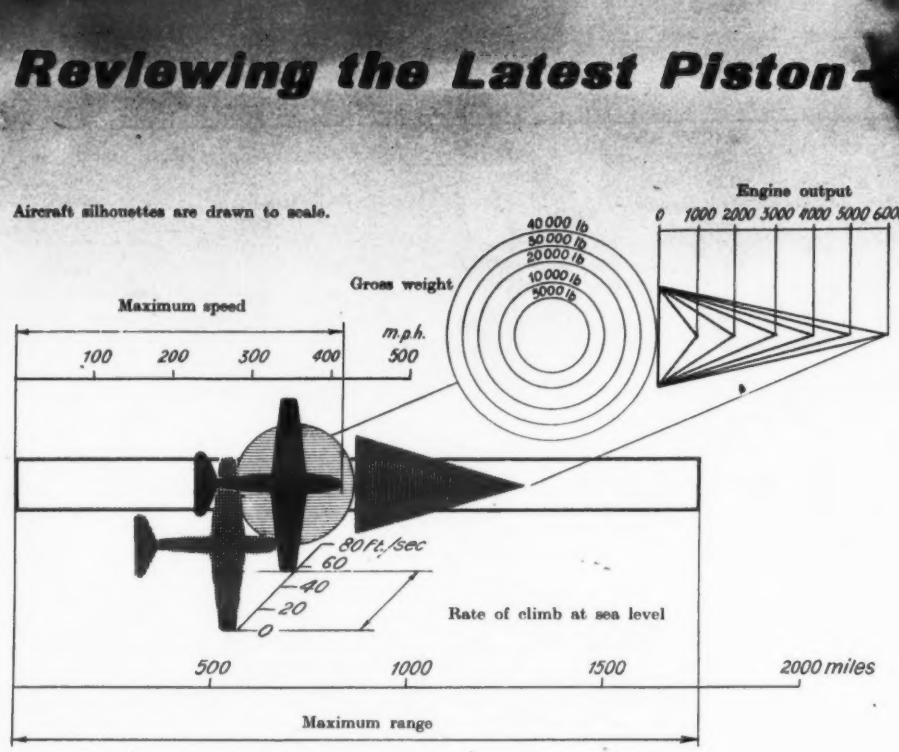
All the same the amphibian has attractive possibilities both for work and play. Anchoring in a quiet bay, bathing, basking and fishing from a rubber dinghy, taxiing on a river sandbank, or going up a flat seashore and pitching a tent—all these delights are open to the amphibian tourist. What a contrast to the flyer who is tied to dusty airfields.

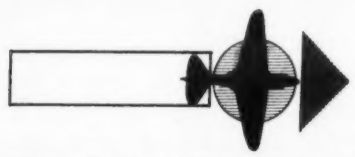
There are cases in which the pilot of an amphibian cannot manage without some external help or special structure. But artificial mooring places or special seaplane bases, where he can anchor his aeroplane for a short time without worrying about it and without being exposed to the curiosity of an invasion of visitors, are still few and far between.

A larger number of suitable docking facilities will only be available once light amphibians are in wider use ; and this will not be the case until amphibians become cheaper. But even in the meantime it is certain that lots of fun is to be had with an amphibian, both from the tourist's and the aviator's point of view, and a feeling of freedom which the pilot of a small landplane can never hope to experience.

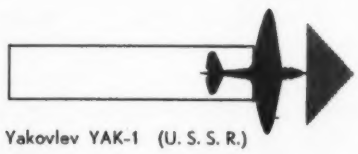
Ri.

Reviewing the Latest Piston-Engined Fighters

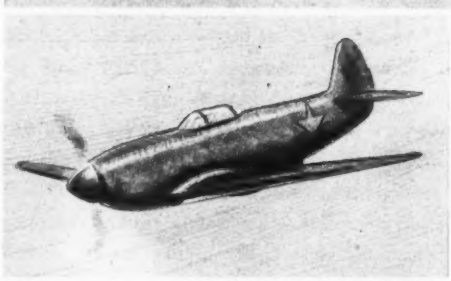


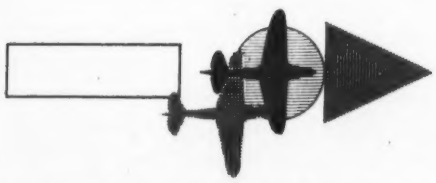


Mikroyan-Gurevitch MIG-3, MIG-5 (U. S. S. R.)

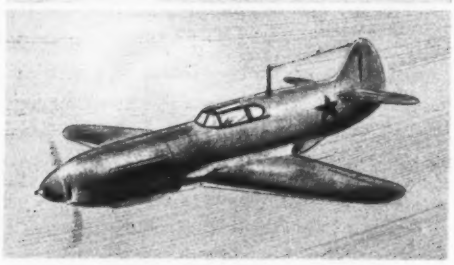


Yakovlev YAK-1 (U. S. S. R.)





Lavotchkin-Gorbunov-Gudkov LAGG-3, LA-5, LA-7 (U. S. S. R.)



This is the first of a series of tables, informally arranged and intending to provide a survey of existing aircraft types.

Why write about piston-engined fighters, it may be asked, when the future evidently belongs to jet-propelled fighters? The objection is quite justified. However, we are not going to discuss the future here, nor the past, but make a survey of the aeroplanes of today.

An example: at the beginning of 1948 the operational flying equipment of the U.S. Air Force and Navy comprised the following makes of fighter and single-seater attack aircraft (piston-engined types in italics) :—

Air Force : *Republic P-47 "Thunderbolt"*
North American P-51 "Mustang"
Northrop P-61 "Black Widow"
Lockheed P-80 "Shooting Star"
North American P-82 "Twin Mustang"
Republic P-84 "Thunderjet" ;

the three last-named fighters are in serial production.

Navy : *Grumman F6F "Hellcat"*
Grumman F7F "Tigercat"
Grumman F8F "Bearcat"
Chance Vought F4U "Corsair"
McDonnell FH "Phantom"
Douglas AD "Skyraider" ;

of these six types the last four are in serial production.

The following are not yet in commission but are being put into production :—

For the Air Force :
North American P-86 ;

and for the Navy :
Chance Vought F6U "Pirate"
McDonnell F2H "Banshee"
North American FJ
Martin AM "Mauler."

Thus there are seventeen types already or about to be commissioned, ten of which are equipped with piston engines ; twelve of them are in serial production, five of these having piston engines. These figures show the level and trend of development very clearly.

A similar picture applies to the Royal Air Force and perhaps also to the Soviet Air Force. Even the countries which are currently equipping a few of their squadrons with jet fighters are glad to keep additional units fitted out with conventionally-powered fighters from Allied surplus stocks, in practice and in readiness.

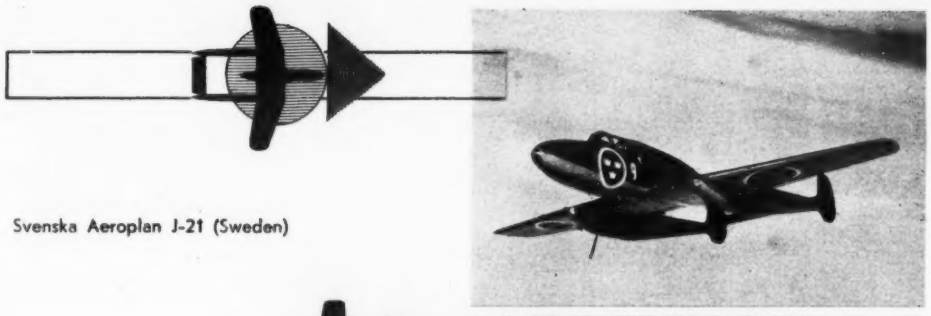
Overleaf we have listed those types that are powered by piston engines and are still "alive" today. Some of those still "on parade" could easily be dispensed with, despite their prowesses of days gone by ; others are represented by their latest versions or newest developments, some having being built up to 1947. Of the latest prototypes, we have listed those which are still being tested, regardless of whether they are patterns for future production or only a basis for development.

In these tables the aeroplanes are arranged roughly according to their all-up weight, without regard to their country of origin. Let us consider what they show us.

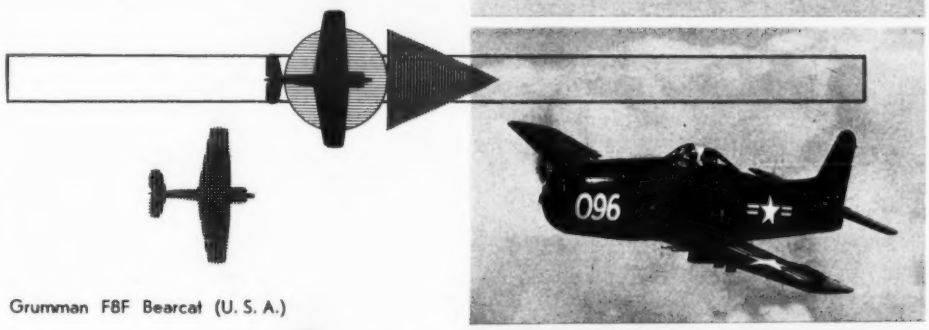
In the first group come automatically the more or less well-known single-seater fighters used by the Soviet Union in the War and since surpassed in weight and performance by all present-day fighters. No great importance can be attached to the scanty data available, which only refer to the three obsolete basic types from which a considerable part of the existing and doubtless more effective Soviet Air Force equipment may have been developed. But little information concerning this new equipment has seeped through the proverbial iron curtain.

Then the original J-21, developed during the War in Sweden, no longer comes up to the standard of a modern fighter owing to its weak engine. However, the fact that a version fitted with a jet engine has been tested and is also being developed into an attack aircraft, the A-21, is indicative of the possibilities still inherent in this construction.

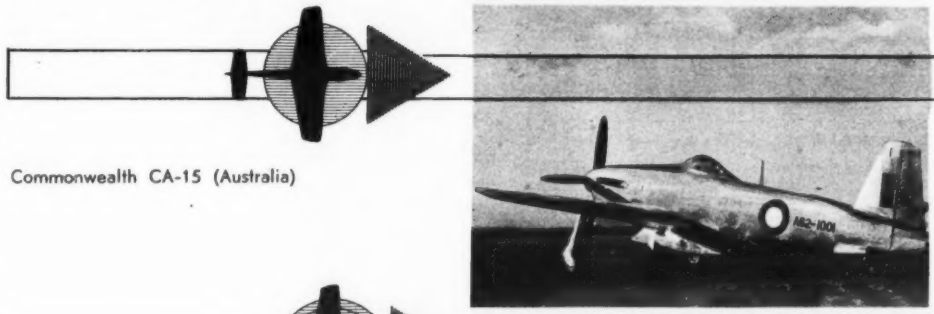
The subsequent group of types could be called classical single-seater fighters in last stage of perfection attainable with piston engines. Where their maximum speed has not been sacrificed to other considerations it lies between 460 and 490 m.p.h. : only jet fighters are faster. The last developments of the traditional "Spitfire" ("Spiteful" and "Seafang") and of the "Mustang" (P-51H) are equal to latest types such as the "Bearcat" light carrier-borne fighter, with its great climbing power, and the versatile "Fury."



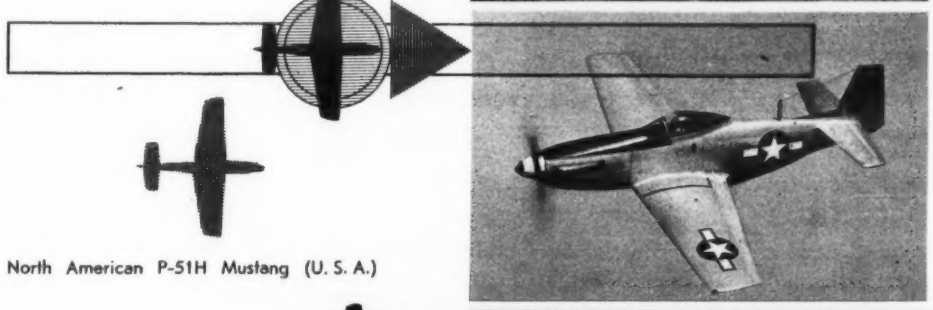
Svenska Aeroplan J-21 (Sweden)



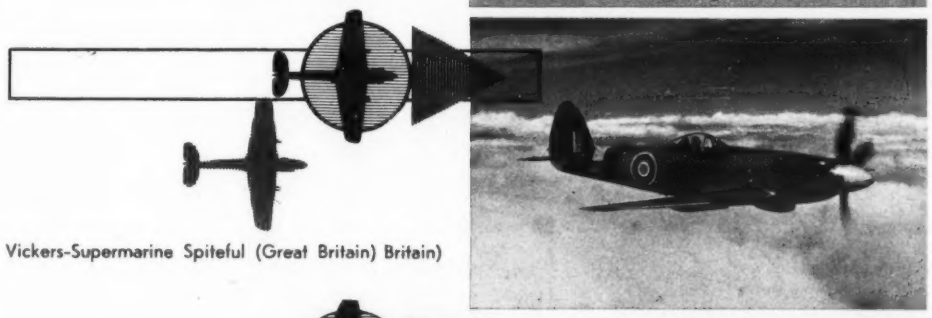
Grumman F8F Bearcat (U. S. A.)



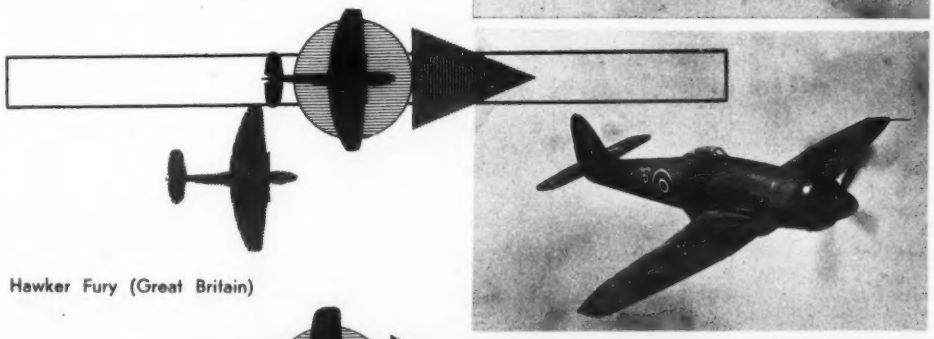
Commonwealth CA-15 (Australia)



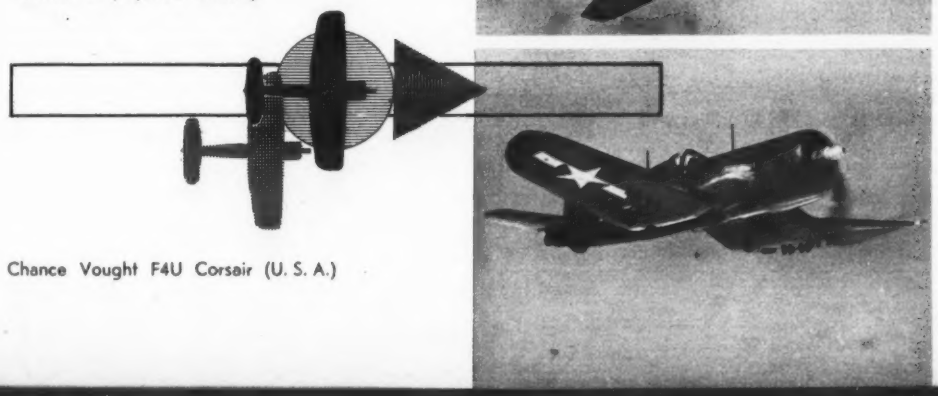
North American P-51H Mustang (U. S. A.)



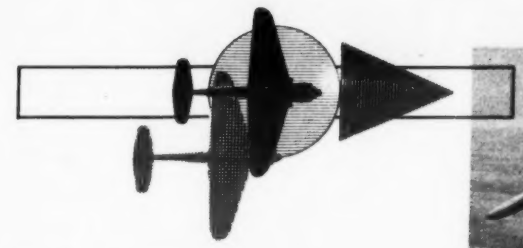
Vickers-Supermarine Spiteful (Great Britain) Britain)



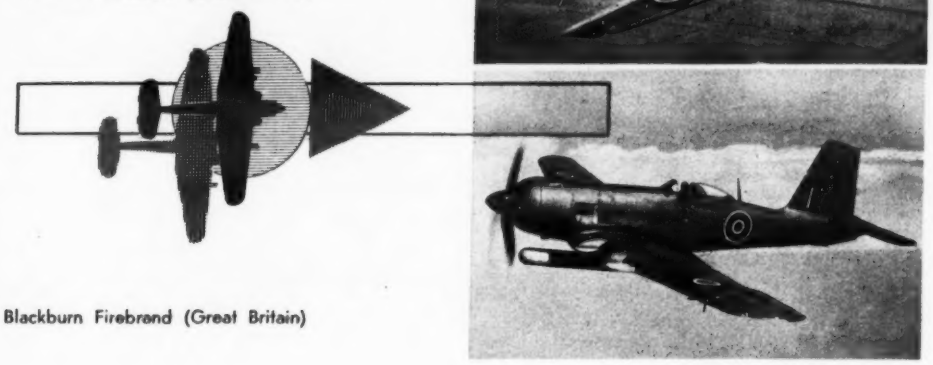
Hawker Fury (Great Britain)



Chance Vought F4U Corsair (U. S. A.)



Blackburn Firecrest (Great Britain)



Blackburn Firebrand (Great Britain)

The first-mentioned modern developments are both distinguished from their famed predecessors by the trapezoidal plan-form of their laminar-flow aerofoils and by the fact that they no longer feature the characteristic widened wing-roots of the "Mustang" and the elliptical plan-form of the "Spitfire" wing.

From the Chance Vought "Corsair" to the Blackburn "Firecrest" the all-up weight increases at a bound by 2,800 lbs. This clearly demonstrates the transition from the light single-engined to the heavy single- or twin-engined types which are intended not only for fighter operations but, for the most part, for various attack purposes.

First come the four single-seater torpedo-fighters (better described as strike aircraft or, according to the U.S. Navy, attack aircraft.) These comparatively slow models should be compared with the Westland "Wyvern,"

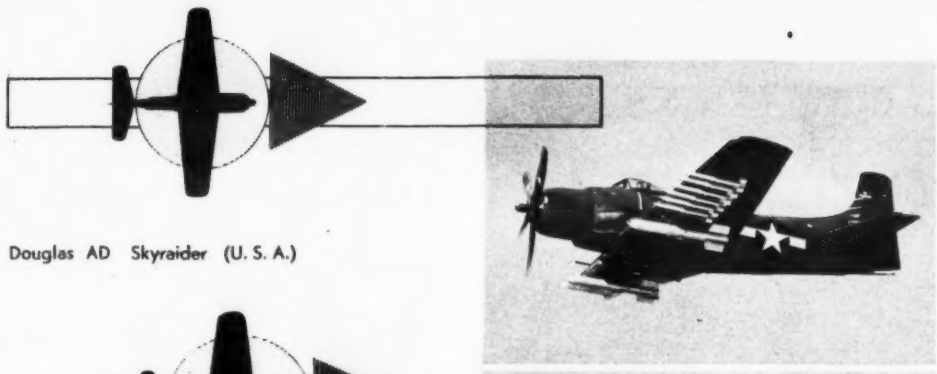
Country	Manufacturer or Designer	Designation	Power Plant	Max. Power H. P.	Dimensions			Weights			Max. speed m.p.h
					Span ft. in.	Length ft. in.	Wing area sq.ft.	Normal gross weight lbs.	Wing loading lb./sq.ft.	Power loading lb./H.P.	
U.S.S.R.	Mikoyan and Gurevich...	MIG-3, MIG-5	1 × AM-35 A	1,200	37' 6"	31' 2"	....	6,200	....	5.2	360
U.S.S.R.	Yakovlev	YAK-1, YAK-9....	1 × M-105 P	1,200-1,600	*c.* 33'	28'	....	....	....	....	*c.* 375
U.S.S.R.	Lavochkin, Gorbunov, Gudkov	LAGG-3	1 × M-105 P	1,200						6.2	350
U.S.S.R.	Lavochkin	LA-5	1 × M-82 F	1,600	*c.* 32'	28'-29'	187	*c.* 7,400	40	4.6	385
U.S.S.R.	Lavochkin	LA-7	1 ×	1,800						4.1	390
Sweden	Svenska Aeroplan	J-21	1 × Svenska Flygmotor DB 605 B	1,455	38' 1"	34' 3½"	239	9,150	38.3	6.3	398
U.S.A.	Grumman	F8F-1 Bearcat	1 × Pratt & Whitney R-2800-34W Double Wasp	2,800 [1]	35' 6"	28' 3"	244	9,300	38	3.32	455
Austral.	Commonwealth	CA-15	1 × Rolls-Royce Griffon 61	2,035	36'	36'	253	9,500	37.5	4.67	442
U.S.A.	North American	P-51H Mustang....	1 × Packard V-1650 Merlin	2,000	37' 1/4"	33' 4"	235	8,450-11,500	36-49	4.15-5.67	460
G.B.	Vickers-Supermarine	Spiteful	1 × Rolls-Royce Griffon 61, 64, 69, 89 or 90 with five-blade airscrew ..	2,375	35'	32' 11"	210	9,950	47.4	4.19	483
G.B.	Vickers-Supermarine	Seafire		2,375	36' 11"	33'	246.6	10,200	41.3	4.30	452
G.B.	Vickers-Supermarine	Seafang	or Rolls-Royce Griffon 87 with contra-rotating three-blade airscrews	2,375	35'	34' 1"	210	10,450	49.75	4.40	475
G.B.	Hawker	Fury I	1 × Napier Sabre VII	3,055	38' 4"	34' 8"	284.5	12,012	42.3	3.94	483
G.B.	Hawker	Sea Fury X	1 × Bristol Centaurus XVIII	2,560	38' 4"	34' 7"	280	12,028	43	4.70	439
U.S.A.	Chance-Vought	F4U-4 Corsair	1 × Pratt & Whitney R-2800 Double Wasp ...	2,300	40' 11 3/4"	33' 8 1/4"	314	12,526	39.9	5.45	450
G.B.	Blackburn	S.28/43 Firecrest...	1 × Bristol Centaurus 59	2,840 [1]	45'	39' 3½"	361.5	15,300	42.4	5.39	380
G.B.	Blackburn	Firebrand IV	1 × Bristol Centaurus IX	2,500	51' 3½"	39' 1"	381.5	15,671	41.1	6.28	334
G.B.	Blackburn	Firebrand V	1 × Bristol Centaurus IX	2,500	51' 3½"	39' 1"	381.5	16,347	43	6.53	340
U.S.A.	Douglas	AD-1 Skyraider....	1 × Wright R-3350-24 Cyclone	2,400	50' 1/4"	39' 3 1/4"	400.33	16,120	40.3	6.71	300
G.B.	De Havilland	Hornet I	2 × Rolls-Royce Merlin 130/131	2×2,030	45'	37'	361	16,100-20,900	44.6-58	3.96-5.15	472
G.B.	De Havilland	Sea Hornet XX....	2 × Rolls-Royce Merlin 130/131	2×2,030	45'	37'	361	18,250	50.6	4.50	472
G.B.	De Havilland	Hornet III	2 × Rolls-Royce Merlin 130/131	2×2,030	45'	37'	361	19,470	54	4.80	472
U.S.A.	Martin	AM-1 Mauler	1 × Pratt & Whitney R-4360-4 Wasp Major ..	3,000	50' 1"	41' 8"	496	19,500	39.2	6.50	350
G.B.	Westland	Wyvern I	1 × Rolls-Royce Eagle 22	3,550	44'	42' 3"	....	19,194	....	5.40	456
U.S.A.	North American	P-82 Twin-Mustang.	2 × Packard V-1650 Merlin	2×2,200	51' 3"	34' 1/4"	408	20,000	49	4.55	475
France	Arsenal	VB 10	2 × Hispano-Suiza 12Z (tandem)	2×1,480	50' 10"	42.7"	382.1	20,613	54	6.97	435
U.S.A.	Grumman	F7F Tigercat	2 × Pratt & Whitney R-2800 Double Wasp ...	2×2,800 [1]	51' 6"	45.5"	455	21,620	47.5	3.86	427
G.B.	De Havilland	Mosquito Mk. 36 ...	2 × Rolls-Royce Merlin 113/114	2×1,640	54' 2"	41.6"	454	21,400	47.1	6.51	404
G.B.	De Havilland	Sea Mosquito Mk. 33	2 × Rolls-Royce Merlin 113/114	2×1,640	54' 2"	41' 6"	454	22,000	48.5	6.70	385
U.S.A.	Northrop	P-61 Black Widow .	2 × Pratt & Whitney R-2800-65 Double Wasp.	2×2,100	66'	48' 9"	664	28,217	42.5	6.70	375

[1] With water injection [2] Only for ferry flights without combat load [3] With only one auxiliary tank of 90 Imp. Galls. [4] Without auxiliary tank [5] Light 0.303-in. M.G.'s

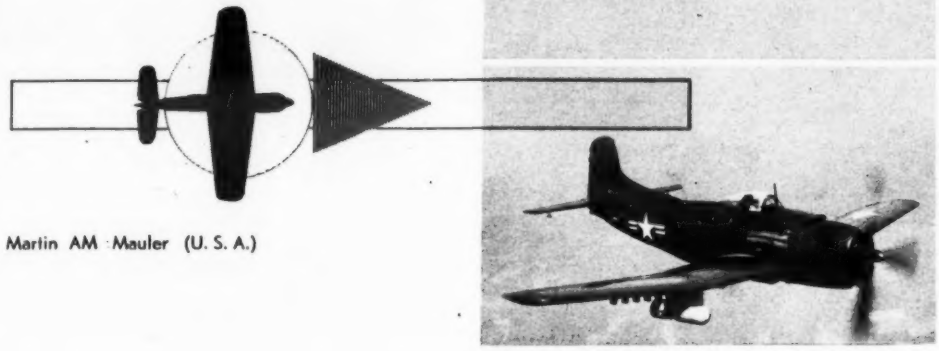
37-mm. c

shown on page 140, which is equipped with the most powerful piston engine in the world and is therefore considerably faster. All five are designed for use in conjunction with aircraft carriers. Their chief task is to attack enemy shipping with torpedoes, rocket projectiles and bombs. Only as secondary duty have they to deal with enemy defence fighters, according to the usual single-seater fighter tactics, with machine-guns, cannon and rocket fire from their fixed, forward-firing armament. In this domain they are impeded by their necessarily inferior flying performance, and have to be escorted by other fighters. The "Wyvern" represents the first attempt at creating a high-performance torpedo aircraft, fairly free from these shortcomings and consequently able to function as a real torpedo *fighter* aeroplane.

Next in order of weight are the twin-engined, long-range fighters for escorting heavy bombers



Douglas AD Skyraider (U. S. A.)

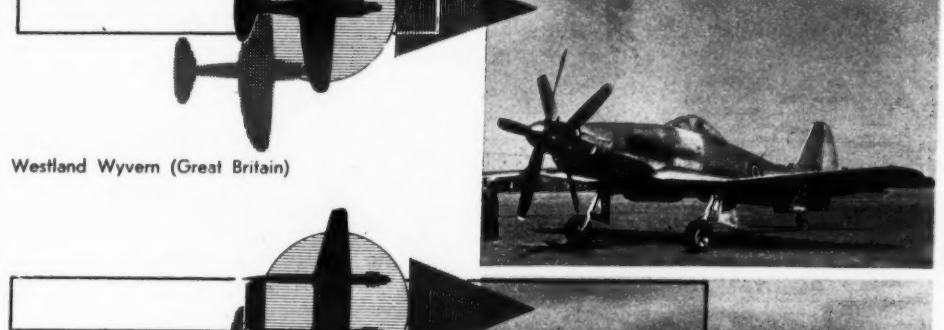


Martin AM Mauler (U. S. A.)

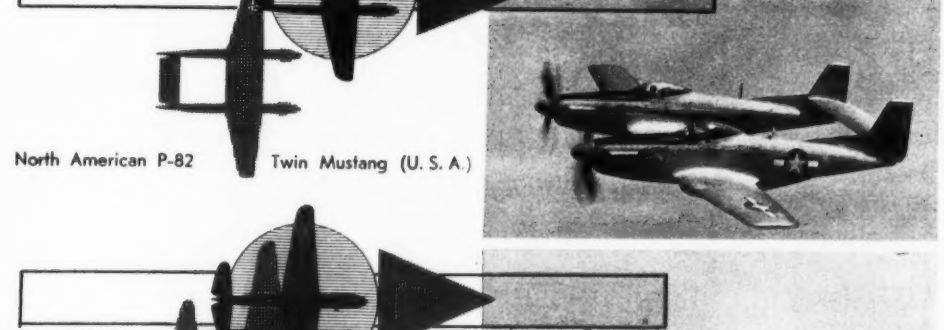
Performance				Built-in Armament		Armament, Auxiliary fuel tanks (choice of)	Observations Later versions
Max. speed m.p.h.	Rate of climb ft./sec.	Ceiling ft.	Max. range miles	0.5-in. M.G.	20-mm. Cannon	T = Torpedoes A = Auxiliary Tank (Total volume) R = Rocket missiles B = Bombs	
360	....	....	500	1+2 [5]	—	6 R of 55 lb.	
c. 375	....	....	c. 650	2	1	6 R of 55 lb.	
350	....	....	c. 430	2	1	6 R of 55 lb.	
385				—	2	4 B of 110 lb.	
390				—	2+1 [6]		
398	....	....	....	4	1		
455	108	42,300	2,200 [3]	4 or	4	4 R of 5 in. B total 2,000 lb.	
442	....	34,000	2,540	6	—	10 R + 2 B of 500 lb. 2 B of 1,000 lb. A 200 Imp. Galls. + 2 B of 500 lb.	
460	106.6	42,000	2,000	6	—	10 R of 5 in. 2 B of 1,000 lb. A 110 U. S. Galls.	Last completely converted version (1945)
483	81.5	42,000	1,315	—	4	4 R of 300 lb. 2 B of 1,000 lb. A 180 Imp. Galls.	Mk. XIV with Griffon 69 ; Mk. XV with Griffon 89 or 90 [7]
452	80	43,100	940 [3]	—	4	R 3 B of 1,000 lb. A 170 Imp. Galls. [2]	Mk. 45 with Griffon 61 ; Mk. 46 with Griffon 61, 64 or 87 ; Mk. 47 with Griffon 87
475	77.1	42,000	1,120	—	4	4 R of 300 lb. 2 B of 1,000 lb. A 180 Imp. Galls.	Mk. 31 with Griffon 69 ; Mk. 32 with Griffon 89 or 90
483	90	42,000	1,790	—	4	12 R of 60 lb. 4 R of 180 lb. 12 B of 1,000 lb. A 180 Imp. Galls.	
439	78	43,500	1,780	—	4	A 90 Imp. Galls + 4 R of 180 lb. A 90 Imp. Galls. + 8 R of 60 lb. A 90 Imp. Galls + 2 B of 500 lb.	Development Sea Fury XI naval fighter-bomber
460	57.5	41,600	1,620 [3]	6 or	4	8 R of 5 in. 2 B of 1,600 lb. A 300 U. S. Galls.	Replaced by latest F4U-5 production version
380	35	30,350	900 [4]	2	—	1 T + 2 B of500 lb. 2 cannon of 35 mm. 280 Imp. Galls.	
334	35	28,500	1,480	—	4	1 T of 1,650 lb. 2 B of 1,000 lb. A 280 Imp. Galls.	single-seater torpedo fighter
340	35	28,500	710 [3]	—	4	1 T of 1,850 lb. 2 B of 1,000 lb.	single-seater torpedo fighter
300	....	25,000	1,500	—	2	total 4,000-6,000 lb. : 1 T 12 R of 5 in. + 2 R of 12 in. ("Tiny Tim," 1,300 lb.) B A	single-seater naval attack aircraft
472	77.5	35,000	2,910	—	4	2 B of 1,000 lb. A 400 Imp. Galls.	
472	77.5	35,000	3,000	—	4	6 R B total 2,000 lb. A 200 Imp. Galls.	Single-seater naval fighter ; also Mk. 21 two-seater night-fighter version
472	77.5	37,500	3,000	—	4	.... A 400 Imp. Galls.	Long-range single-seater
350	....	....	1,700	—	4	total 4,000 lb. : T + R or B + R	Naval single-seater attack aircraft
456	58.3	32,100	1,180	....	....	1 T of 20 in. + 8 R of 60 lb. 1 R "Uncle Tom" + 8 R of 60 lb. A 180 Imp. Galls.	single-seater torpedo-fighter
475	88	45,000	3,000	6	—	25 R 8 M.G. of 0.5 in. 4 B of 1,000 lb. A	One- or two-seater P-82E long-range or night-fighter version has two Allison V-1710 units of 2,230 H.P.
435	33.5	36,100	1,615	6	4	4 R + 2 B of 1,100 lb.	
427	71	36,000	1,015 [4]	4	—	2 T of 22 in. B total 4,000 lb. A 150 U. S. Galls.	Also in F7F-2N, -3N and -4N two-seater night-fighter versions
404	45.8	36,000	....	4 [5]	4	1 T of 18 in. B total 1,000 lb. in fuselage + 2 B of 500 lb. A	Two-seater night-fighter Mk. 38 version, longer nose. Also as Mk. 41 fighter-bomber
385	50	30,000	1,680	—	4	1 T of 18 in. 8 R of 60 lb. 4 B of 500 lb.	Two-seater naval fighter
375	43.3	33,000	1,900	event. 4	4	B total 6,400 lb. A 610 U. S. Galls.	Three-seater night fighter

[2] 37-mm. cannon [7] Also Mk. XVI with R.-R. Griffon 101 of 2,420 H. P.; max. speed 494 m.p.h. — world's fastest piston-engined aircraft

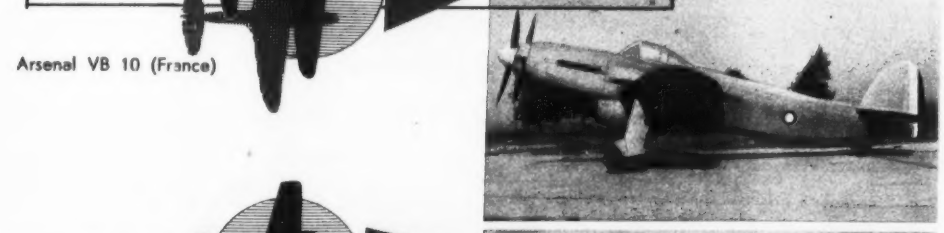
De Havilland Hornet (Great Britain)



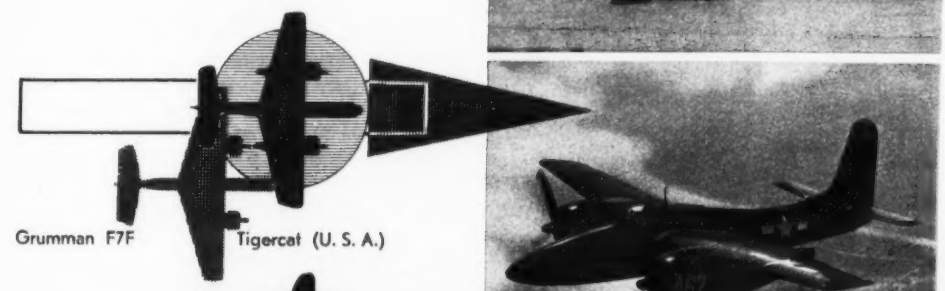
Westland Wyvern (Great Britain)



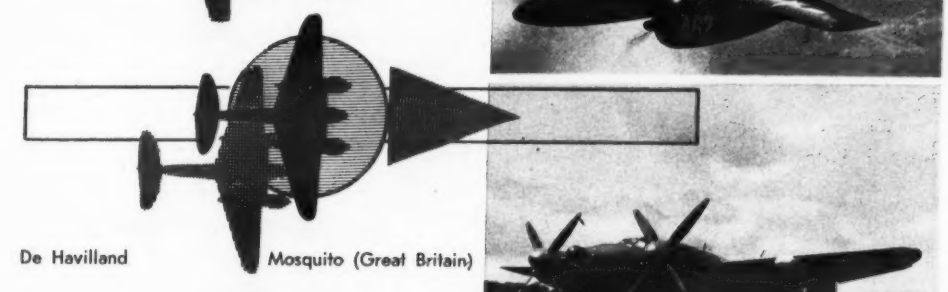
North American P-82 Twin Mustang (U. S. A.)



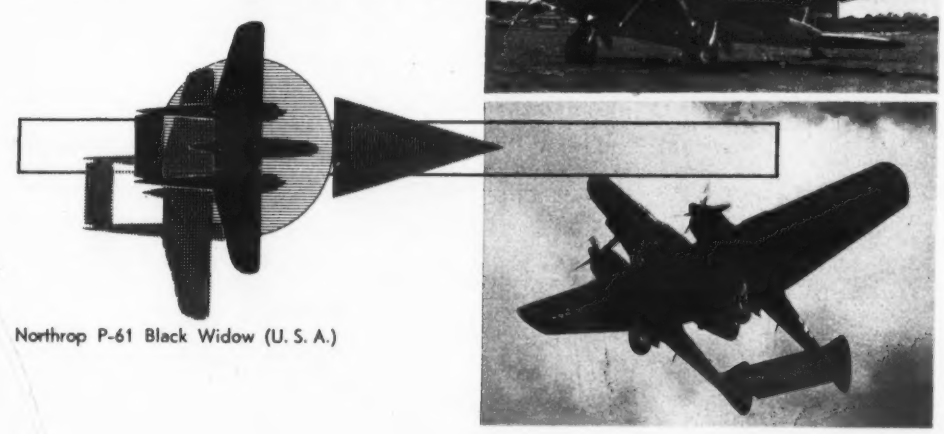
Arsenal VB 10 (France)



Grumman F7F Tigercat (U. S. A.)



De Havilland Mosquito (Great Britain)



Northrop P-61 Black Widow (U. S. A.)

or for operations at long distances from the mainland. The "Hornet" and "Twin Mustang" are equal in climbing capacity and speed to the light defence fighters powered by only one piston engine.

Finally our list contains some twin-engined night fighters and naval fighters which take a second crew member for the radar equipment, the "Black Widow" ev . . taking an extra gunner for the free machine guns. Is it a coincidence that these heaviest fighters are not equipped with the most powerful piston engines available and show inferior performance data as their size increases ? We do not think so : the purpose of a fighter, even a night fighter, calls for a degree of manoeuvrability which simply cannot be attained by large types ; and the multi-seater "destroyer aircraft" has always remained a passing design of the last war.

The high-speed jet fighter is gradually usurping the original task of the piston-engined fighter—offensive and defensive combat of aeroplane against aeroplane. Already in the course of the last war the fighter was not serving this purpose alone, but was also attacking both fixed and mobile targets on land and sea. The variety of armament equipping the types listed here shows that the conversion of piston-engined fighters is making progress. In this sphere the pure jet fighter is not directly a superior opponent as far as performance is concerned. Undoubtedly the piston-engined fighter retains two advantages : low fuel consumption and short take-off distance. The former makes long flights possible, the latter the use of aircraft carriers or advanced positions. In a word, *range* in the most general sense is the feature of these types now developing from the fighters of World War II as instruments of strategy—a "peacetime strategy" which does not expect war on a wide front but the task of protecting widely-dispersed bases and small mobile fleets against local offensives. *T.*

The Flight of the Cauliflower

Just as all who wear khaki uniforms are not necessarily soldiers, everyone employed by an airline company does not have to be a flyer. This applies to a particularly good friend of mine who works for a trans-Atlantic carrier. Like most people who arrange journeys for others he has a perfect horror of travelling himself and is quite happy to remain unromantically earthbound. His hide-out is a lonely settlement of wooden huts around an airfield in mid-Atlantic, where airliners normally stop on their way between the Old World and the New.

On the whole, he is content with his lot and assures me that he doesn't envy his more opulent patrons in the least—especially when he sees them landing every day, miserable because their journey isn't finished and doubly miserable because another route section lies before them. As a matter of fact his life would be just perfect if it weren't for one snag—the food. It's not that he doesn't get enough to eat ; nothing could be further from the truth, for the supplies come from America, the land of plenty. Nor has he a queasy stomach ; that certainly wouldn't do for an airline employee, not even one who has to stay on the ground. To appreciate his dilemma you must first remember that my friend is a Frenchman. And whereas Uncle Sam may simply abound with good qualities in one way and another, you have to admit that he can't hold a candle to Marianne when it comes to grub. However, it's not about any lack of flavour or variety that my friend grumbles, but about the fact that everything seems to come out of tins. And eating vegetables out of tins is just as horrible to a Frenchman as drinking Scotch out of a cup is to an Englishman or an American.

However, where there's a will there's a way, and my friend wrote to his mother who now makes a practice of sending him a couple of pounds of carrots, peas or leeks, by air every week. And a short while ago she went one better. He got a letter saying that she was sending him a cauliflower by the next plane. Now, to a Frenchman, a cauliflower is not merely something you boil. Capable Gallic hands can make of it a dish so succulent as to tickle the nostrils of the gods. And thus my friend, his mouth watering in anticipation, began picturing to himself what he would do with it. Should he prepare it *sauté,* or serve it with a delicately-spiced white sauce, or with tomato sauce just slightly perfumed with garlic ? Finally, he visualized it *au gratin,* with rich, creamy Gruyère cheese bubbling slowly underneath a golden-brown crust.

When the great day arrived he was on duty in charge of landings. Two hours before the scheduled arrival he contacted the plane—but alas, only to pass on a message he had received from the Met service : "Ceiling too low. Unless other orders given, don't-land here."

The minutes were like hours, and my friend gazed almost imploringly at the thick blanket of fog enveloping the field. In the airliner the passengers were not the least bit perturbed about the fog. "Somebody down below is keeping a sharp eye on us," they said to themselves. They were quite right, but they didn't know that the sharp eye down below was far more concerned about a cauliflower in the plane's hold than about themselves.

Meanwhile, the fog refused to lift, and my unfortunate friend finally had to radio the plane to fly on direct to New York.

With a heavy heart, he trudged sadly back to his hut and savagely ripped open a tin of spinach. Later in the day, however, his spirits revived. He remembered that cauliflowers keep. "If it had arrived," he told himself, "I should have eaten it already. The day after tomorrow the plane will come back from New York and, *voilà,* I shall have my cauliflower."

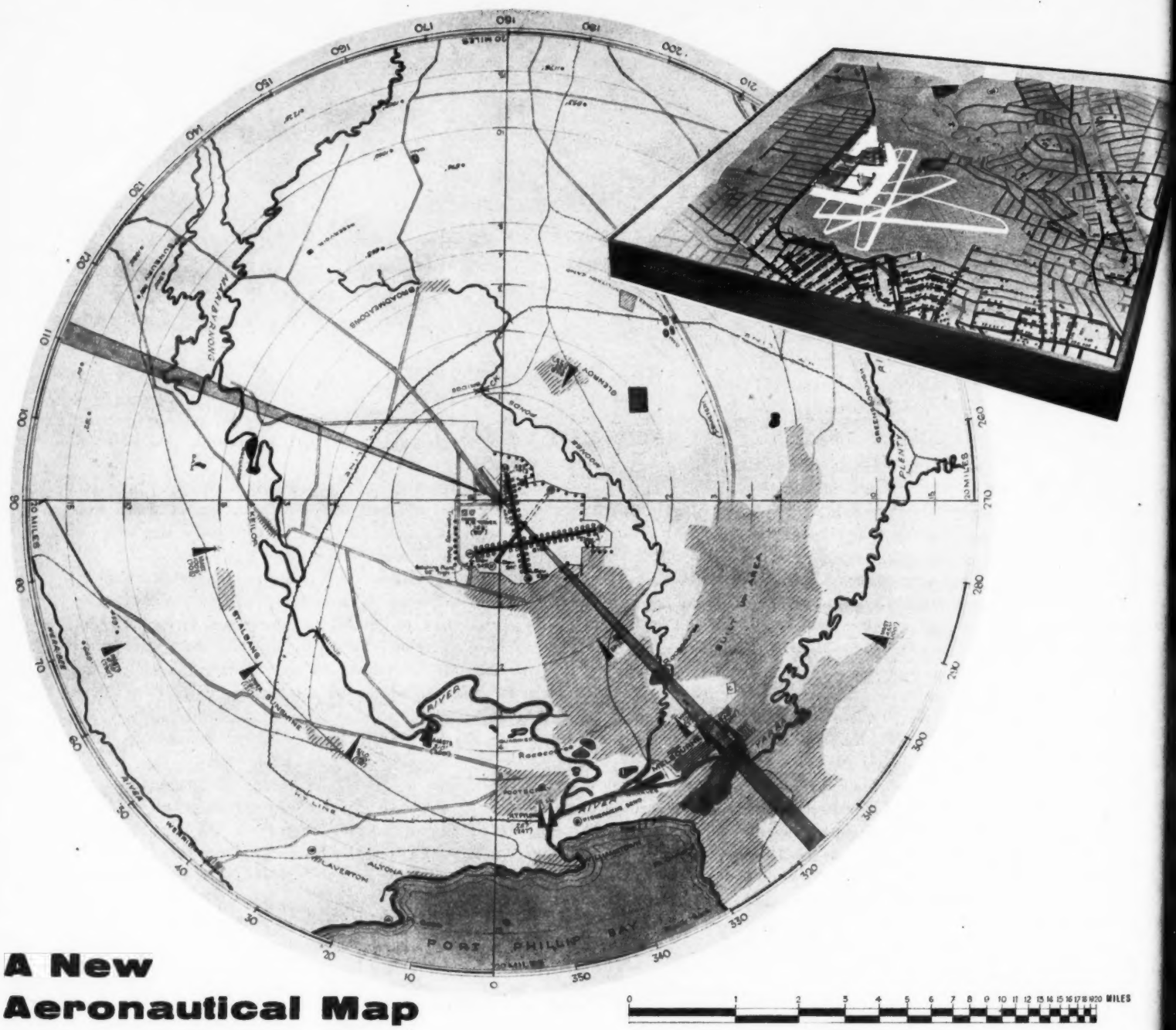
But the poor man couldn't have been more mistaken. I suppose you have already guessed why, but, just in case, I'll tell you : instead of lifting, the fog became thicker than ever ; the plane flew straight back to Europe—taking the cauliflower with it.

* * *

We ate the cauliflower in Paris, in the little flat close to Montmartre belonging to my friend's mother. The gallant vegetable was no worse for its journey, but in order to make it go a little further our kind hostess decided to garnish the dish—with tinned spinach.

Yves Grosrichard.

11.35 hours on a rather bumpy night over mid-Atlantic and all's well.
"— Did you ring, sir ?"



A New Aeronautical Map

Many pilots look upon their maps as unwanted ballast, to be reduced to a minimum if the weather is not too bad, or, if circumstances permit, even left behind. The aeronautical map is one of those good friends we always forget until the moment comes when we are in trouble.

Pilots are not solely to blame for this very widespread and mistaken idea. A handy aeronautical map is an extremely rare commodity : all we generally find are ordinary route maps which serve as a basis for rough navigation, or maps giving certain sections on a large scale. Private flyers approaching unfamiliar airfields mostly have to put away their route map and hunt through a whole bundle of separate charts for the large-scale plan of the specific landing area. In bad weather, it is left to the pilot to find the best method of transferring from one map to another.

These problems are usually of less importance for commercial airline pilots. The latter have complete series of charts on board in any case, and a navigator or co-pilot is always ready to supply any details in sufficiently good time. But even the airline pilot would appreciate a route map which simultaneously depicted airports on an increased scale.

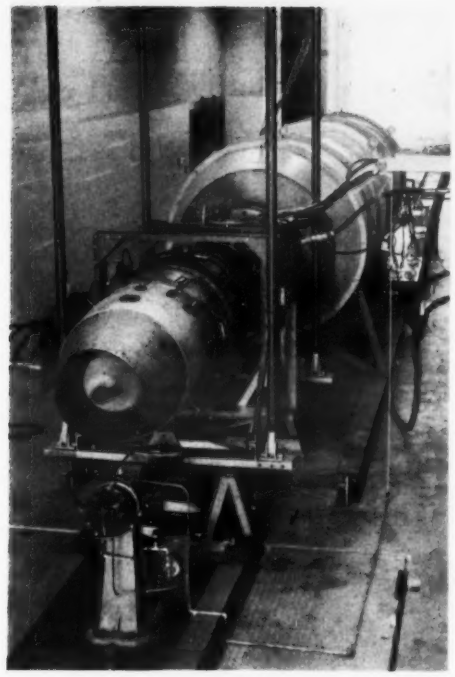
An Australian expert, *W.E. Pyke, A.F.R.Ae.S.*, Chief Cartographer to the Australian Department of Civil Aviation, who has often had to deal with these problems during his twenty years' experience in the branch, has recently hit upon a solution which is as simple as it is practical. He has devised what he names the "Transitional Approach Chart," which, by medium of a continual change of scale, gives a realistic interpretation of vision on approaching an airport. The rate of decrease of scale is arbitrary. In his specimen map of Essendon Airport, Victoria, Mr. Pyke uses the logarithmic scale of the common slide rule. An inner circle with the airport as centre, having in this case a radius of about a mile, is undistorted. Outside this inner circle a logarithmic diminution of the scale occurs, until at an optional distance of between fifteen and twenty miles it returns to the usual scale of the standard aeronautical chart of the locality. In the transitional zone concentric circles indicate the real distance from the airport. These concentric circles can also be graduated to show circumferential miles at that radius.

Mr. Pyke's idea fills a hiatus felt, consciously or unconsciously, by every pilot. His chart really does give that oblique-photo type of picture confronting a pilot as he descends and closes in on an airport.

The new chart lends itself particularly for mapping terrain at the junction points in a network of strip maps. These usually begin and end at some relatively important aerodrome. It would be possible here to supplement the various strip maps by a single local chart for the airport on a logarithmic scale, which could be used in conjunction with all the usual approach route maps for the area. This would constitute an appreciable simplification. As the various artificial aids, obstructions, buildings, etc., at airports are always changing, the use of logarithmic airport charts would obviate the constant re-printing of new route maps.

The Australian Department of Civil Aviation is now trying out Mr. Pyke's chart, specimens of which have been submitted to ICAO headquarters for consideration at the next meeting of the Aeronautical Charts Division. Meanwhile, its interest extends to military and private aviators as well : the R.A.F. and the aviation authorities of several countries are already testing the possibilities of this cartographic innovation. *Bi.*

How Does Icing Affect Gas Turbines ?



Test set-up seen from the exhaust end of the Jumo 004. In the background is the cylindrical inlet air duct containing the water spray nozzles.

In spite of all advances in aeronautical engineering, in spite of the invention and application of numerous safety devices in the course of the last decades, Fog and Ice, the two arch-enemies of aviation, continue to claim their victims. It is true that meteorological services have attained such a high standard that it is rare for a transport aircraft to have to make a forced landing with the almost certain prospect of a crash because of ground fog. In the air, too, fog is no longer considered dangerous, for it has been conquered by blind-flying instruments, new methods of navigation and, more recently, by radar obstacle-warning devices.

The same applies to protection from icing. Here again crews can count on the reliability of the meteorological services, which accurately inform them in advance of the dangerous icing zones. Mechanical and thermal de-icing and anti-icing systems serve to break up or prevent icing on aeroplanes and, together with accurate navigation, eliminate all hazards. Airscrews, too, have been made safe by fluid anti-icers and, of late, by the installation of electric heaters or rubber anti-icers.

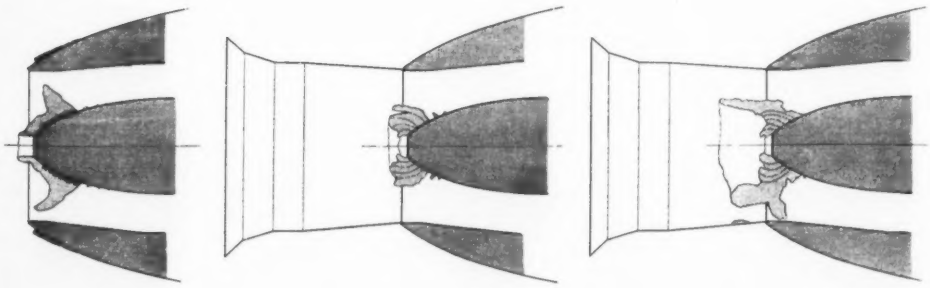
However, it is not only the icing of wing, empennage and airscrews which causes big commercial airliners on the Atlantic scheduled run to disappear without trace, in spite of all precautions, or private and military aeroplanes to encounter difficulties and crash in mountainous regions. *Carburettor icing* in reciprocating engines, for instance, has always been a menace, which, even in lower-power units, engineers have sought to combat by adopting special types of induction system and installing heating devices.

The question arises today whether *gas-turbine engines*, too, suffer a loss in output owing to ice formation, or even whether icing exposes them to danger. Commercial transport aeroplanes, which may be forced to fly for prolonged periods in icing zones in order to keep their course, have not yet been fitted with jet engines. The newest military jet aeroplanes are not too greatly affected by these problems as yet, since they are designed for operating at levels where icing does not occur ; and furthermore, their great climbing power enables them to pierce rapidly through atmospheric layers where this danger exists.

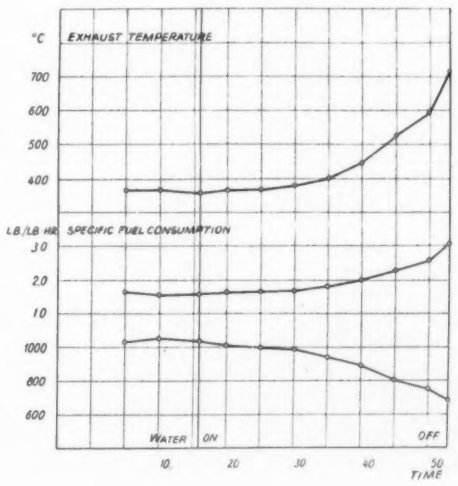
Gas-turbine engines for aircraft were developed in all countries during the war years. It is therefore not surprising that hitherto only scanty details have been made available to the public as to precautions against icing taken for gas turbines. In this respect, a number of basic questions can be answered by briefly outlining certain preliminary icing experiments carried out in the last few years by the *National Research Council of Canada*. The Canadian experiments concerned test-stand runs with a German Junkers Jumo 004/B1 jet engine, one of the best-known turbo-jets with eight-stage axial-flow compressor and single-stage turbine.

In order to simulate to as great an extent as possible the icing conditions occurring in flight, a twenty-foot length of approximately five-foot diameter duct was mounted

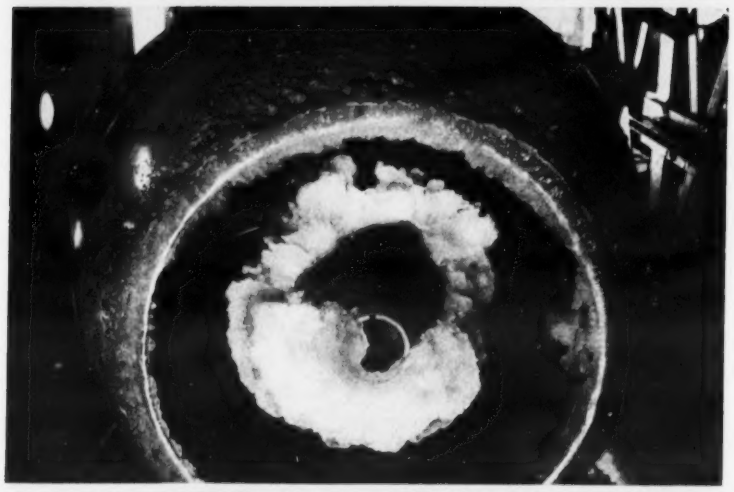
Trial run with Jumo 004 at 7,600 r.p.m. ; water injected for 37 minutes at 18 feet from compressor inlet ; quantity of water, 0.8 lb./min. ; ambient temperature, —5.8 deg. C. ; 73 per cent. air humidity ; 13.2 lbs. of ice formed on the starter fairing.



Ice on the starter fairing ; left : " coronet " form with the regular nose cowling ; centre : " rose " form at the beginning of the icing, with straightener applied ; right : " tulip " form (after 60 minutes).

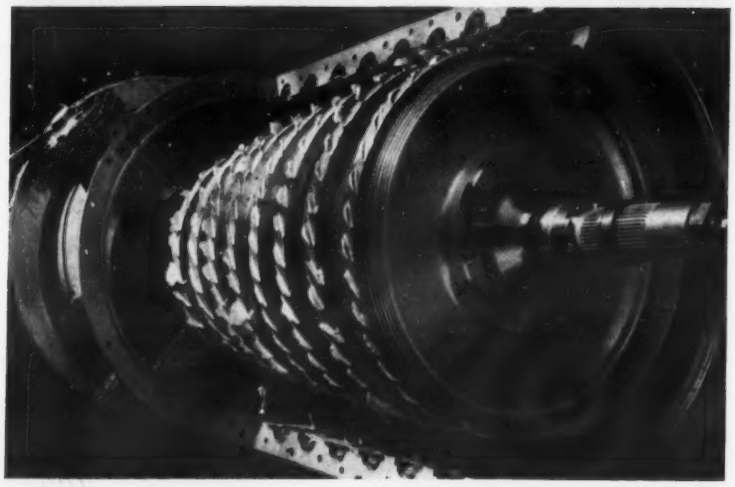


a) *" Coronet " formation and slight icing of cowling.*



b) *A piece of " coronet " is broken off.*

c) *A turbine blade can be damaged by quite a small piece of ice.*



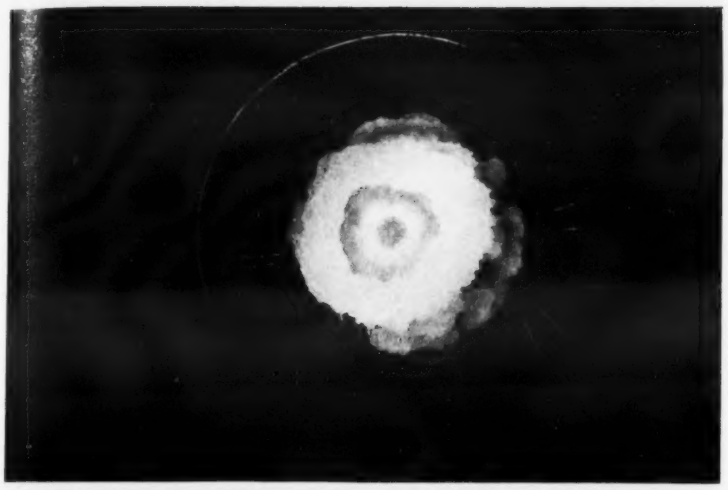
d) *The ice which has entered the compressor has demolished all the rotor blades.*

in front of the jet unit and water spray nozzles were placed in it at various distances from the compressor entry. The compressor end of the air duct and the outer nose cowling were connected by a flexible seal that prevented air entering the unit other than by the open end of the duct, but did not interfere with thrust measurement. The water spray nozzles used in the tests produced droplets of varying magnitudes, their diameters ranging from 5 to 170 microns. Water was supplied to the nozzles under pressure from a tank on weigh scales with provision for cooling : in most of the tests a water rate of about 1.2 lbs. per minute was used, corresponding to approximately 0.6 grams per cubic metre of air. An earlier Canadian Research Report (R.A.E. Report No. SME. 3380) gave the maximum amount of free water in the atmosphere in icing conditions against which the jet engine should be protected as one gram per cubic metre. It may be seen that the injection of 1.2 lbs. of water per minute, as applied to these tests, corresponded to 60 per cent. of this figure.

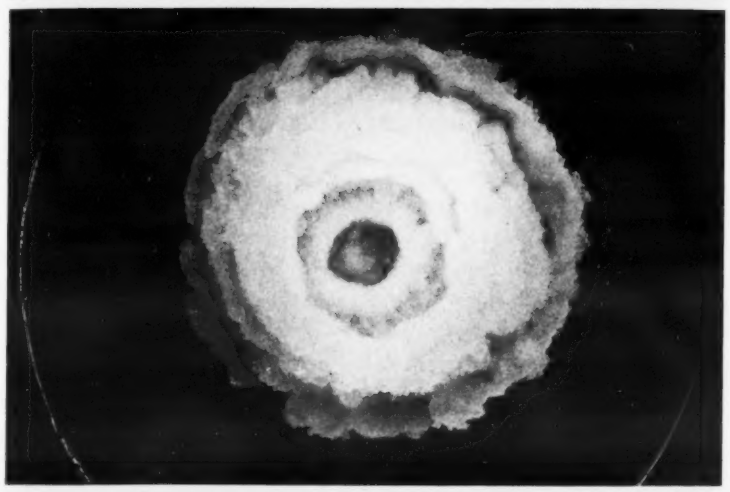
Most of the icing runs were made at low outside temperatures, engine operating conditions being standardised at a speed of 7,600 r.p.m., with the exhaust bullet disconnected from its driving motor and locked in the open or regular starting position.

In a first series of experiments, using the regular engine cowling of the Jumo 004, considerable quantities of ice built up on the front part of the starter fairing, nearly always assuming a characteristic form. At first the water froze to form separate rings of ice which, at about three inches from the leading edge, usually began to grow radially towards the nose cowling. These ice formations, called " coronets, " sometimes attained diameters equal to five sixths of the inlet diameter, thus threatening to block the entire air inlet. Their structure varied : the lowest layers were usually of coarse-grained, porous ice, while the outside part was sometimes a milky glaze and sometimes clear ice. Though runs were usually stopped as soon as a " coronet " had reached a fair size, the ice mostly stuck hard to the starter fairing, so that only small splinters could fly into the compressor. In one run, however, a piece of " coronet " weighing between three and six pounds broke off and promptly demolished all the rotor blades and stator vanes of the compressor. Meanwhile, it was generally found that icing took rather a long time to begin but thereafter increased rapidly and very soon blocked a considerable part of the inlet. Icing of the guide vanes further downstream occurred only rarely and to a slight extent.

Since ice build-up at the compressor entry naturally depends mainly on the air flow conditions in front of and in the nose cowling,

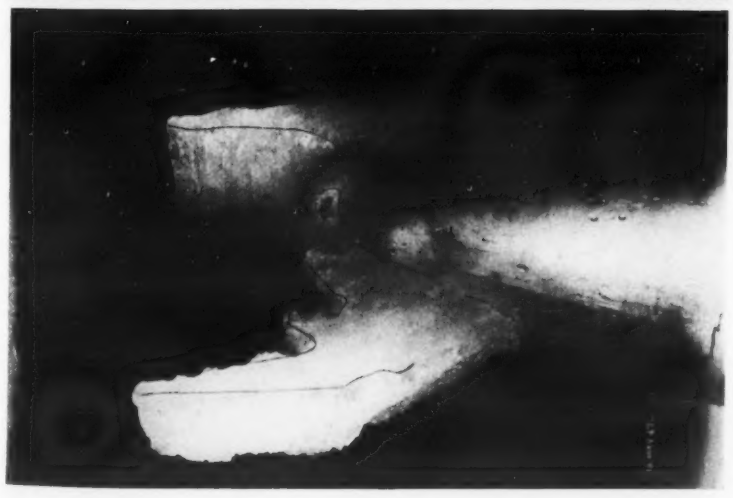


a) *" Rose " formation when flow straightening was applied ; 6 lbs. of ice formed ; ambient temperature was —4 deg. C.*



b) *Further growth of " rose " at high speed (8,400 r.p.m.)*

c) *A " tulip " grows against the air stream.*



d) *A sectioned " tulip."*

and therefore changes with the aircraft speed, the experiment was made of fitting a bell-mouthed straightening entry producing stream lines approximately the same as those occurring in flight. Though it could be proved by using a smoke-generating apparatus that the flow was more nearly parallel to the walls than before, there was still a concentration of water droplets near the centre of the air stream. This of course meant an increase in the number of droplets impinging on the starter fairing and a reduction in those striking the guide vanes—which is not the case in flight conditions.

When the air flow was changed the icing took on another shape. It no longer grew radially across the entry, but more or less axially towards the front, producing what is referred to as a " rose " formation, which did not block the entry so noticeably. After long test runs its " petals " would grow forwards and gradually assume the shape of a " tulip. " Ice was frequently noticed on the guide vanes, and though this did not extend beyond the first compressor stage, it was sufficient to damage the rotor. Because the compressor inlet was not blocked to as great an extent as in the first series of runs, the output losses were smaller as a result of " rose " and " tulip " type ice formations. However, it did happen that one engine was destroyed in these tests, when a " tulip petal " broke off and entered the compressor.

The effect of icing on engine performance was clear in all cases : decreased thrust, increased exhaust temperature and increased fuel consumption. It must be remembered here that the bench experiments were not limited by the decrease in thrust, so important during flight, but by the exhaust temperature on the one hand and, on the other hand, by the desire not to have the engine damaged by pieces of ice at every run. As the exhaust bullet was locked, the normal exhaust temperature was a little over 350 deg. C. Icing, however, usually caused it to rise to 700 deg. C. within 30 to 40 minutes ; at the same time specific fuel consumption was doubled, and thrust dropped 15 to 20 per cent.

It would be premature to draw fundamental conclusions on the basis of the Canadian experiments. These were test-stand trials in which flight conditions were simulated only very approximately. Nevertheless, they do provide pointers for flight tests and clearly illustrate the necessity for adequate protection of the compressor blades.

Bi.

The Installation of Gas-Turbine Engines

BY J. GOSPODAROVICZ, PARIS

We need only make a review of what are considered to be successful types of aeroplane in order to understand the great importance attaching to methods of engine installation. It is clearly evident that satisfactory performance can only be attained if the latter is " tailored " to fit the airframe. For this reason the engine designer must always bear the installation problems in mind ; and the airframe designer, while his project is still in the blue-print stage, must dispose of the engine in such a way that maximum output and optimal operative conditions will be available. Logically, therefore, this calls for the closest collaboration between the two specialists.

Whereas we already have standard specifications for disposing and mounting piston engines, this cannot yet be said of gas-turbine power plants. Our experience of them is too recent and their particular problems differ too greatly from those we have so far been used to. First we must remember that gas-turbine engines are intended primarily for high-speed aeroplanes, of which the external configuration may differ from the ordinary. Moreover, aerodynamic operative conditions affect gas turbines just as much as thermal conditions, with the result that they must form a unit with the airframe much more than the conventional piston engine. Meanwhile however, it must be noted that whilst progress is being made in actual turbine design, their installation methods are developing, too. Since the advent of this new form of prime mover, considerable improvements have been made in air and fuel ducting, lubrication systems, safety-, regulating- and control-devices. In the paragraphs which follow, we shall consider the installation problems one by one.

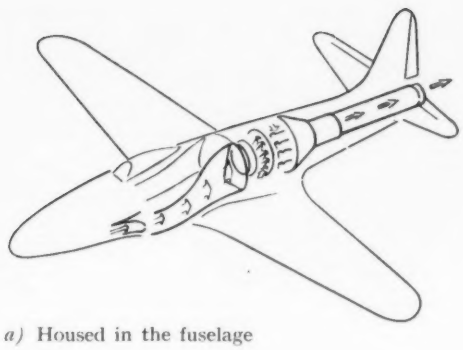
General Disposition

Although gas-turbine engines have only been in practical use for a comparatively short time, it is already possible to distinguish between various methods of disposing them in relation to airframes (cf. Fig. 1).

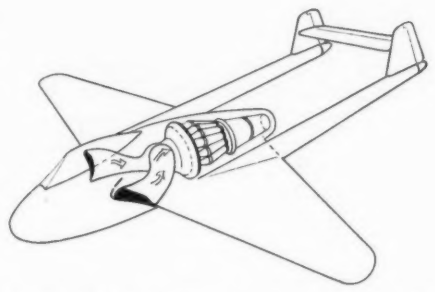
Installation in the fuselage (Fig. 1*a*), often adopted for light fighters such as the Lockheed " Shooting Star," the SO 6000, the Vickers-Supermarine " Attacker," Douglas " Skystreak," etc., offers appreciable advantages and cuts down parasite drag. More space is offered for mounting and, furthermore, thin aerofoil sections with low drag coefficients can be used. The disadvantages, on the other hand, are the exceedingly-long jet-efflux nozzle required, making if difficult to install protections against fire, the unfavourable conditions for cooling the engine, and the frequent necessity for very cumbersome arrangements for the air intake, the air usually having to pass through pressure-raising diffusers of increasing cross-section. As a rule, this arrangement is only selected for single-engined aeroplanes, and engine maintenance is frequently coupled with inconveniences. Meanwhile, many of these disadvantages disappear in the case of aircraft with nacelle-type fuselage and tail-booms, such as the de Havilland " Vampire," for instance (Fig. 1*b*).

Installation in the sides of the fuselage (Fig. 1*c*), enabling light aeroplanes to be fitted with two engines, has not been widely used hitherto : some German aeroplanes followed this pattern, and so does a U.S. carrier-borne fighter, the McDonnell FD-1 " Phantom." It involves considerable structural difficulties, as the engines have to be buried in the wing roots. Furthermore, the fuselage interferes with the air flow at the intakes, and the hot jet stream has to brush the fuselage skin. The same maintenance difficulties arise as in the preceding case.

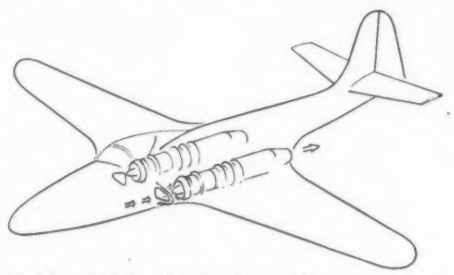
Wing installations comprise two arrangements : the turbo-jet can be built directly into the wing ; one or more units, singly or in groups, can be slung beneath the wing. The two arrangements are advantageous as regards ease of accessibility and servicing, and conditions are good both for air entry and jet efflux. *Direct wing installation*, as in the Gloster " Meteor " (Fig. 1*d*), calls for a specially-constructed wing and involves an increase in drag. In the case of all-wing types, however, such as the Northrop XB-49 with its eight General Electric TG-180 turbines (Fig. 1*e*), designers make use of the structural thickness and particular construction of the wing to bury the engines completely. *Suspension under the wing* (Fig. 1*f*) simplifies the problem : it is no longer necessary to alter the wing structure, and this method offers the possibility of pro-



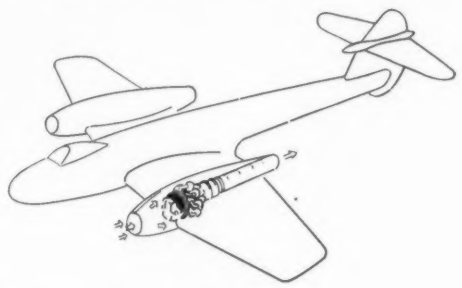
a) Housed in the fuselage



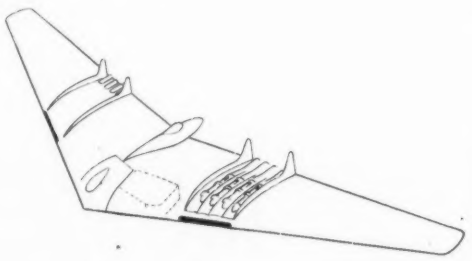
b) Housed in the rear of a nacelle-type fuselage



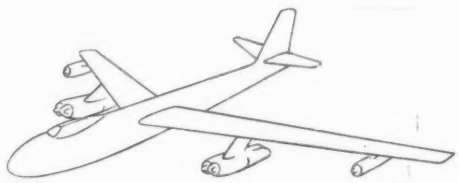
c) Mounted in the fuselage sides



d) Built into the wing



e) Buried in the wing



f) Slung beneath the wing

Fig. 1 : Methods of installing jet engines.

viding standardised self-contained power units, similar to the piston-engine " power eggs," which are quickly and easily interchanged. This method of installation has been adopted for the majority of jet bombers now developing, e.g., North American XB-45, Convair XB-46, Boeing XB-47, Martin XB-48.

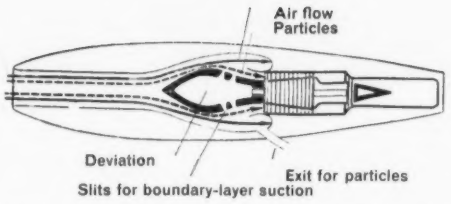


Fig. 2: Straight-flow to a turbo-jet with axial compressor, with built-in inertia-eliminating device.

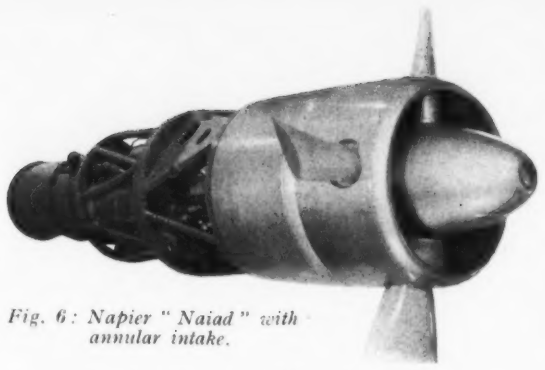


Fig. 6: Napier " Naiad " with annular intake.

Air Circuits

The air flow circuits take precedence in all installation questions. In present-day turbo-jet units, about 40 to 50 kgs. of air flow every second through the engine, and it is expected shortly to double or treble this figure. (In comparison it may be noted that a 1,000-H.P. piston engine needs only 1 kg. of combustion air per second.) Such quantities of air can only be supplied at the expense of turbine output, of which 60 to 80 per cent. is needed to drive the compressor. Meanwhile, an improvement of ten per cent. in the expenditure of output for the air supply can bring about a 30 per cent. increase in thrust and consequently a very considerable reduction in specific fuel consumption. There are two different ways of achieving this improvement, depending on the design of the turbo-jet :—

turbo-jets with straight air flow (Fig. 2), either with axial compressor (e.g. Westinghouse, General Electric TG-180, Metrovick, Junkers) or single-entry radial compressor (de Havilland) ;
turbo-jets with return air flow, with double-entry radial compressor (Rolls-Royce, General Electric J-40) necessitating a collector chamber.

In both cases the turbo-jet inhales the air at low velocity under normal conditions of take-off and ascent, but this velocity augments as the aircraft's speed increases. The cross-section of the compressor's inlet as well as the cross-sections of the passage through the compressor must therefore be designed as a compromise between take-off and maximum speed requirements. One of the most important design factors is the ratio between the velocity of air entry and the flying speed.

In *straight-flow turbo-jets*, this velocity ratio may approach unity, because it is possible to adapt a perfect entry diffuser. Then the engine nacelle offers only slight drag, as the streamlines are fairly straight. The small inlet section of the diffuser allows for air intakes to be installed in the wing leading edge (D.H. " Vampire " with D.H. " Goblin " engine, McDonnell " Phantom " and " Banshee " with Westinghouse " Yankee " units).

Return-flow turbo-jets, on the other hand, call for a collector chamber in which the velocity of the air sinks considerably. The inlet has a large section and the velocity ratio, limited by the nacelle's drag, is chosen very low ; the streamlines around the nacelle are very much deviated. Nevertheless, the inlet to the diffuser can be kept small if its length is increased (Vickers-Supermarine " Attacker " with R.-R. " Nene," Lockheed " Shooting Star " with General Electric TG-180).

The air intake openings must as a rule be arranged so that their own air flow does not interfere with the flow around the wing and fuselage. They are therefore best placed in the nose of the fuselage, at any rate in the case of single-engined aircraft, such as the Republic " Thunderjet " (Fig. 3). If the engine is installed in or under the wing, very good flow conditions can also be obtained by placing the intake far in front of the leading edge (Fig. 4). In the case of air intakes disposed flat against the fuselage sides (" Shooting Star," " Attacker," cf. Fig. 5) the detrimental effect of the fuselage's boundary layer must be eliminated. The boundary layer must either be abstracted or accelerated in flow direction (as in the case of the " Attacker "). The same applies when the air intake is placed in the leading edge near the wing root.

Inefficiency in diffusers is generally ascribed to excessive flow velocities, too sudden changes in cross-section, and to leakages. The latest experiments have revealed the necessity of providing the air intake with a shut-off flap, so that when an engine fails or is cut out, notably in the case of multi-engined types, it can be isolated. Otherwise the increase in drag caused by the air flowing through the engine would amount to about 15 per cent. at 850 km./hr. and to about 25 per cent. at 950 km./hr.

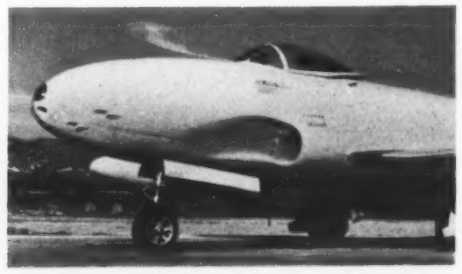
Finally, consideration must be given to *filtering* the air. This problem is of little or no interest in the case of turbines with radial compressors (" Nene " or " Goblin "), which are comparatively insensitive to particles entering, and of which the performance depends very little on the condition of the surfaces. Axial compressors, on the other hand, are easily damaged by particles, as U.S. experiments on German gas turbines have shown. The large quantities of air needed by a turbo-jet prohibit the use of the filtering methods common to piston engines, so that attempts are being made to solve the problem with inertia-eliminating devices, which can be installed without difficulty if the air flows straight through (Fig. 2). The Americans attach particular importance to filtering the air and the National Advisory Committee for Aeronautics (NACA) is carrying out many experiments in this direction.

In the case of *airscrew-turbines* the air intakes are either placed in the leading edges, when the engine is buried in the wing, or as an annular slot around the airscrew spinner (Fig. 6).

Fig. 3: Air intake in fuselage nose.
(Republic " Thunderjet ")

Fig. 4: Intake forward of wing leading edge.
(Gloster " Meteor ")

Fig. 5: Nostril-type intakes.
(Lockheed " Shooting Star ")
Note the boundary-layer bleed arrangement, with vertical inlet and horizontal outlet.



Fuel System

The installation of fuel ducts would not involve any particular difficulty if the fuel consumption were not so high and, as a result of this, so much space had not to be provided for the fuel.[1] In the first place a steady feed must be assured, so that the pumps may not run dry and thereby interrupt the combustion. It is usually very difficult to start a turbine up again in flight and a considerable quantity of electric energy is required.

Nearly all present-day types of aeroplane have an electric booster pump in the main tank, which supplies the high-pressure fuel pumps of the jet engine. This creates a certain pressure—to prevent the engine pumps' running dry—and sees to the filling of the fuel feeds and, in particular, of the atomisation pumps, right from the start. The system must be so designed, however, that a failure of the booster pump cannot simultaneously incur a stoppage of the fuel injection pumps. The ducts should be large and the delivery system should feed the engine even in inverted flight. In cases where a small gasoline engine is used for starting, a separate circuit has to be provided—as in the "Jumo 004." Though this method requires no accumulators, it is not popular among designers. There is a preference for electric starters, which enable the starting process to be controlled automatically.

One of the particularities of jet-engine fuel systems is the installation of dumping arrangements as a precaution against fire or faulty starts. If fire breaks out in the engine the fuel feed must be cut off at once and the contents of the entire circuit dumped overboard; after a faulty start the combustion chambers must first be de-fuelled. Here, too, different arrangements must be made from those applicable to piston engines, for the quantities of fuel are much larger and the dumping must be effected with extreme rapidity. The dumping conduits must therefore be of wide diameter and free from bends.

Lubrication System

The lubrication system of gas-turbine engines is much simpler than that of piston engines. This is due to the small lubricant consumption of turbo-engines: whereas a 1,000-H.P. piston engine consumes 8 to 9 kgs. per hour of lubricating oil, a jet unit of equal potential output needs only about 100 grams per hour.

The majority of current turbo-jets, such as the "Nene," "Goblin," etc., have a closed lubrication circuit. Lubricating oil is sucked out of the sump through a strainer by a pressure oil pump and fed to the bearings through a high-pressure filter. A scavenge-oil pump then leads the scavenge oil back to the sump through a second strainer and a de-aerating device. However, there is evidence of an increasing tendency to adapt open circuits, which eject the scavenge oil overboard without using it again, though this necessitates the provision of thermocouples for supervising the main bearings. In the case of gas turbines with axial compressors, where the installation of an oil sump is not possible, a small oil tank is fitted instead. In this instance, however, more conduits will be needed between the engine and the oil tank.

Airscrew-turbines have a somewhat more complicated lubrication circuit and the oil consumption is greater. The oil must carry away a great quantity of heat, and must lubricate gears and the transmission shaft. It is therefore necessary to fit not only a larger oil tank, but an oil cooler as well.

Mounting Jet Engines

It is not so easy to mount a jet engine as is generally supposed. Vibrations between the engine and the aeroplane must be isolated or absorbed; forces engendered by the engine (weights, torque and gyroscopic loads, thrusts, etc.) must be counteracted; additional tensions due to expansion through heat must be avoided; and finally rapid installation and dismantling of the engine must be possible. Whereas for piston engines elastic (rubber) means of suspension can be selected, this is not possible for turbines owing to the high temperature and considerable effects of expansion and contraction. Metal joints have been used hitherto but it would be an advantage if an elastic material could be developed, capable of absorbing vibrations and standing up to high temperatures. The amplitude of the engine vibrations is very small (0.07 mm for the TG-180, for example) as turbo-engines only have rotary parts turning at high speed, supported on roller bearings. On the other hand, the frequency of the vibrations is very high, corresponding to the rotary speed.

Among the forces which the engineer must bear in mind when designing the mounting, the most important are: engine thrust forces in axial direction; mass forces caused by the weight of the engine and acting perpendicular to the axis; lateral loads imposed during banking and aerobatic flying; gyroscopic loads developed when the aircraft banks or pitches, manifested in the form of a moment which is picked up solely by the lateral mounting points when the aircraft curves, and by the lateral points together with the front or rear pick-up points in the case of a pull-out.

Most turbo-engines have three pick-up points: two main points and one auxiliary suspension link. The main pick-up points guarantee the engine a certain amount of freedom perpendicular to its longitudinal axis. The auxiliary link permits a limited movement about this axis, which may be necessary owing to asymmetrical distribution of the temperature at the engine periphery. Adequate liberty of movement in all directions can be attained with ball-and-socket attachments. An American method of suspension is shown in Fig. 7.

When fitting the jet efflux pipe it must be remembered that the expansion owing to heat may reach a magnitude of 11 mm/metre. The influence of temperature distribution here is an important factor, so that the pipe must be made free to turn about its axis.

Safety Problems

The safety factor must be the concern of both the airframe and the power plant designer. The fire hazard is by no means slight in gas-turbine engines. The large quantities of fuel and combustion air, high speeds and considerable wall temperature increase the risks. For this reason the lubrication circuit is incorporated into the engine, the number and length of the oil and fuel conduits are reduced, and fewer accessories are mounted outside the engine. Fig. 8 gives an example of temperature distribution.

Fig. 7: Three-point suspension of a General Electric turbine.

A. Front pick-up point
B. Lateral main pick-up points
C. Support for jet pipe

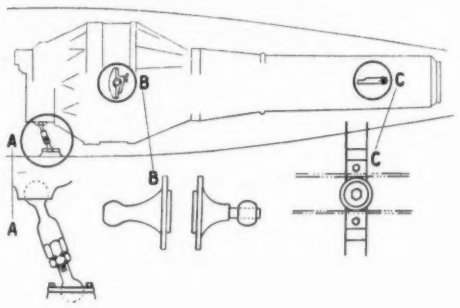
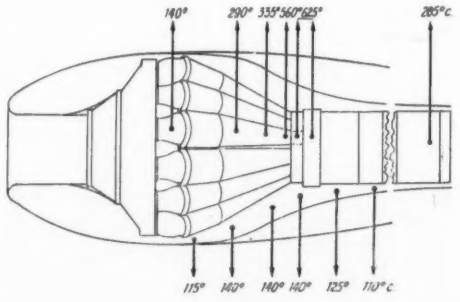


Fig. 8: Temperature distribution of a turbo-engine.



[1] The most commonly used fuel for jet engines is known by the name of *aviation kerosene*, which is a petroleum destillate with a specific weight of about 0.8 kg./lit. and a calorific value of approximately 10,000 kcal./kg.

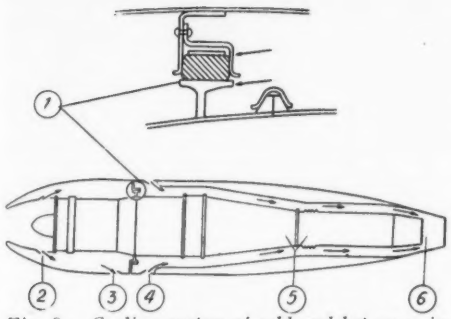


Fig. 9: Cooling system of cold and hot zones in the case of a turbine with axial compressor.

1) Fire-wall between compressor and turbine
2) Cool air enters cold zone
3) Cool air leaves cold zone
4) Cool air enters hot zone
5) Stainless steel lining
6) Cool air ejected by exhaust action

Every jet engine may be divided into two zones, one comparatively cold and the other hot. It is for the airframe constructor to take care that both zones remain separated and that the engine nacelle is protected against temperature effects, either from the combustion chambers or from the jet pipe. If the engines are built into the wing, the latter must also be protected, since the wing unit is more susceptible to the effects of heat than other aircraft parts, owing to the great loads to which they are subjected. An air scoop on the cowling furnishes the cool air for the cold zone, in the forward part of the engine. All the accessories are generally arranged in the cold zone, where cooling can be assured without great difficulty.

Fig. 9 shows the protective installation for a turbo-jet with axial compressor (TG-180). The cold zone is separated from the hot zone by a firewall and ventilated through a duct branching off from in front of the diffuser. The spent cooling air then passes out underneath. The hot zone, however, acquires its cooling air through a scoop above the nacelle cowling, and makes use of the ejector effect of the exhaust gases. The interior of the part of the nacelle surrounding the hot zone is lined with stainless steel of 0.4 to 0.5 mm. in thickness.

Besides these protective measures, the safety system proper contains fire warners and extinguishers.

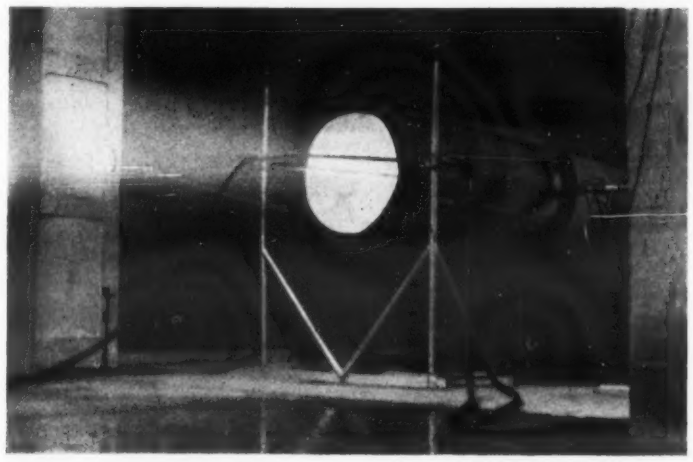
This chapter on the safety aspects of gas-turbine installation would be incomplete if no mention were made of the *maintenance* side. It must necessarily be to the detriment of safe operations if the engine cannot be serviced properly, so that the engineer, while designing the installation method, must constantly bear in mind that all vital engine parts must be easily accessible. Manufacturers always furnish a list of those parts which need to be dismantled frequently. The parts which must be easily accessible may be mentioned in order : the accessories mounted in front (in engines with radial compressor) and on the compressor casing (in engines with axial compressor) ; then the combustion chambers and the jet pipe.

The *control and regulation* of gas turbines, and the necessary accessories to these engines, have already been discussed at length in previous issues of this publication.[2] As a rule the instrumentisation common to jet engines is much simpler than for reciprocating power plants, and especially when starting is automatic. The throttle lever may either directly control the injection pumps or a fuel throttle valve.

In conclusion, it may be deduced from the paragraphs above that installing a gas-turbine engine affects the aeroplane structure to a far greater extent than when an ordinary piston engine is mounted. As the turbine must form a unit with the airframe, its installation must be preceded by very careful planning.

[1] Cf. " Interavia, Review of World Aviation," Vol. II, No. 11, p. 35-42 and No. 12, p. 44-46.

RAM JETS ON THE WAY



Ram jet on the test stand : the air stream is maintained by a big blower and pulse recordings at the in- and outlets give information as to the thrust which can be expected.

A piece of stove-pipe thirty inches wide and eleven feet long, with specially-formed walls, a couple of oil burners and a built-in grid—that is the description of the new aeroplane " engine " being tested at present by Marquardt Aircraft Company, a little-known firm in Venice, California. And this simple mechanism, known as the ram jet, is said to develop greater thrust at its design speed than the most powerful turbo-jet engine now available in the U.S.A.

But there is a catch in it : in principle, ram jets are only suitable for very fast aircraft. Marquardt's experimental duct is constructed for a flying speed just equivalent to sonic speed—which is 760 m.p.h. at sea-level. Even at this high speed, which manned aeroplanes have hitherto only exceeded in occasional test flights, and is far above the official world record, the efficiency of the ram jet is still hopelessly low. In point of fact, it burns about four times as much fuel as a turbo-jet of the same output.

The result would be better if higher speeds could be flown. A 50 per cent. increase in flying speed, thus to 1,140 m.p.h., would entail a multiplication of the thrust by 2.25—signifying an increase sharper than that of the air resistance, whose coefficient decreases again beyond the sonic barrier—while fuel consumption would be stepped up only 50 per cent.

In the case of such secret experiments it is of course difficult to get hold of useful numerical data on the results obtained. Nevertheless, the Marquardt Company have announced that their ram jet, at design speed conditions, gives more than 10 lbs. of thrust for every pound of engine weight, or about 30 thrust horsepower per pound of weight. From this second figure we can calculate a thrust of nearly 15 lbs. If, however, we take the first figure of 10 lbs. as a basis, we can estimate—still for 1 lb. of engine weight—the hourly total consumption at 40 to 50 lbs. of fuel, or more than 2 to 2½ lbs. per horsepower. For piston-engine and airscrew-driven types in the normal speed range, and for turbo-jet aircraft at the highest speeds so far attained, this figure is less than 0.65 lbs. per thrust horsepower.

If we could install the ram jet in an aeroplane capable of 1,140 m.p.h., perhaps, according to the above, it would produce 22 lbs. of thrust or 67 thrust horsepower per pound of engine weight and, accordingly, consume 60 to 75 lbs. of fuel per hour. In this way the figures would be stepped down to around one pound of fuel per horsepower-hour, thus in the neighbourhood of tolerable consumption.

The weight of the ram jet is nothing in comparison to that of its fuel. As has been said, it only weighs about 1 lb. for every 10 lbs. of thrust, which is only 0.8 ounces or 1/20th of a pound for every horsepower developed at sonic speed, as compared with 0.2 lbs. for turbo-jet engines and at least one pound for a piston engine.

Let us look somewhat more closely at this astonishingly-simple power plant of the future. It consists of a front part about five feet long into which the air flows through a round opening at the great speed with which the aeroplane travels—at the sonic speed of 1,115 feet per second. This foremost part, which is the diffuser, gradually broadens until at the end the diameter, judging by the picture, is almost doubled. This slows the air down and converts part of its kinetic energy into pressure. Fuel injection actually begins in the diffuser section, a number of nozzles being placed on a pipe extending axially from the rear into the air channel. Although a flame would be undesirable in the diffuser, the fuel must be mixed with the air here already so that it can ignite in time, as it only takes the air about four thousandths of a second to get from the fuel injector to the end of the diffuser. Here a part is played by delayed ignition, which has been thoroughly investigated for the combustion processes in reciprocating engines and which is accomplished for the latter by advancing the instant of ignition or, in the case of Diesel engines, of injection. In the case of large marine Diesel engines, of which the cylinders have about the same diameter as the ram jet under discussion, the few thousandths of a second mentioned would correspond roughly to as many degrees of crankshaft rotation. In this short time the injected fuel has to spread over the entire air flow section and each particle of fuel must be prepared for ignition. It must absorb heat from the surroundings (especially by radiation from the rear part of the nozzle), go through a chemical change bringing the volatile, highly-inflammable components to the surface—and by then it has reached, with the air, the point featuring the greatest diameter. At this point a grid is installed : called the " flame holder " its construction is probably one of the main secrets of the new engine. There is no doubt that it is made of special temperature-resisting material and glows when the engine is running, and it would be interesting to know whether it also carries contact substances, platinum preparations, for instance, for catalytic acceleration of the chemical processes.

One thing is certain : the fuel will certainly not ignite in front of the grid, and only to a small extent behind it ; it will always burn in the desired place, in the combustion chamber adjoining the flame piloting device. The walls of this chamber are of heat-resisting steel and, like a furnace, lined with a ceramic preparation. The combustion takes place in this chamber without any further rise in pressure. The sole effect of all the liberated heat is that the exhaust gases and the superfluous air acquire a greater volume than the cold air inhaled, and must be exhausted at a greater velocity through a given outlet section. The last part of the duct, growing narrower again, ejects the gases into the open at a velocity amounting to about double the flying speed of the aeroplane.

The ram jet, like a turbo-jet, or an airscrew driven by a piston engine or a gas turbine, is thus provided with a device for accelerating the gas masses towards the rear. The reaction of the forces caused by these accelerations propels the device, and thus the whole aeroplane, forwards.

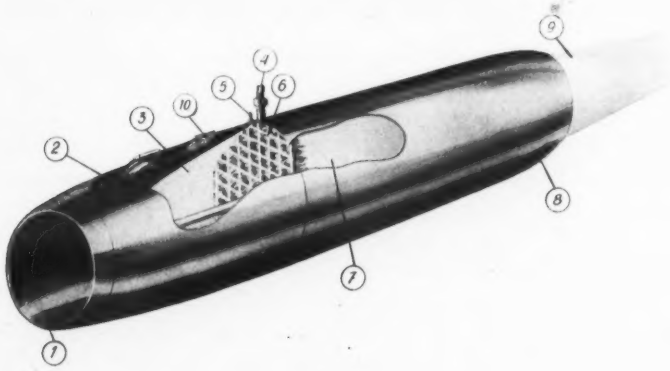
The ram jet is started up by a fuel injector pump driven by a small built-in engine, the injected fuel being ignited by a sparking plug installed near to the flame holder.

This thirty-inch ram jet, constructed by Marquardt's for the U.S. Air Force, is not the company's first ram-jet product. For three years Marquardt's have been working for the U.S. Air Force and the Navy Bureau of Aeronautics on the development of such engines, the Navy work having been done in connection with the University of Southern California. Smaller ram jets of twenty inches in diameter have already been constructed and experimentally installed on a North American P-51 " Mustang," a Bell XP-83 and a Lockheed P-80 " Shooting Star " for the purpose of recording their output. The results are promising, but it will be some years before aeroplanes are available with speeds allowing them to be driven by ram jets with economic advantage. It is likely that rockets will be used for starting such aeroplanes and bringing them up to the necessary minimum speed, in the same way that they are used at present for supersonic research aircraft. On the other hand, ram jets may soon be substituted for rockets, notably in instances where rockets of practicable weight have too short a combustion duration and turbine engines are too expensive ; and also for jet-propelled missiles and the types of pilotless supersonic research machine which are fired from fast-flying mother-aircraft. For though the ram jet may seem an uneconomic proposition compared with present-day engines, at and below sonic speed, it all the same needs only one fifth of the weight of fuel required by a rocket to maintain the same thrust over a definite period of time.

As a one-eyed inhabitant of the kingdom of the blind, the ram jet may soon become king. And by the time the realm of high speeds has been opened to it, it will have learned how to rule. *T.*

The simple construction of the Marquardt Ram Jet :

1. *Air intake*
2. *Diffuser*
3. *Fuel spray*
4. *Fuel supply*
5. *Igniter*
6. *Flame holder*
7. *Combustion chamber*
8. *Exit nozzle*
9. *Exhaust*
10. *Structure*



Views on the Armament of Modern Fighter Aeroplanes

By Gordon M. Gollob, formerly Colonel and Chief of Fighter Requirements, Luftwaffe. *

Figure 3 illustrates two more typical cases with rigid sighting devices. They are of attacks by a Messerschmitt Me 110 on a " Flying Fortress." It will be seen to what extent the success depends on both the firing dispersion and on the range and flight angle from which the gun is fired.

Comprehensive data gained in combat and their careful evaluation indicated for how long one had to fire certain types of gun in order to score the *number of hits necessary for destruction* (dependent on the firing dispersion) at different ranges. Assuming that *high-explosive ammunition* is used, the following number of hits are needed to bring down a bomber of the " Flying Fortress " type :—

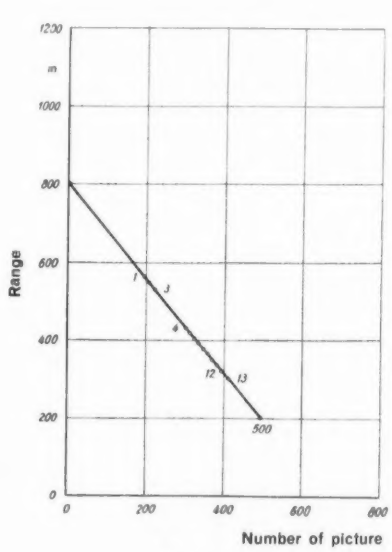
Calibre :	Number of hits required :
55 mm.	1 hit
30 mm.	4 hits [2]
20 mm.	20 hits

Taking the " Flying Fortress " as an example, and presupposing the gunner to be of average skill, approximately *two shots in a hundred are hits.* If two guns are used simultaneously, thus firing twice the number of rounds, four hits can be expected. These hits bring the opponent down if the guns are of 30-mm. calibre and high-explosive ammunition is used. To bring an aeroplane down with a 20-mm-calibre gun, 20 hits are needed, and therefore five times as many rounds, that is to say, 1,600 shots must be fired. As it can be assumed that in all cases the gunner has the same time at his disposal, the following conclusions can be drawn :-

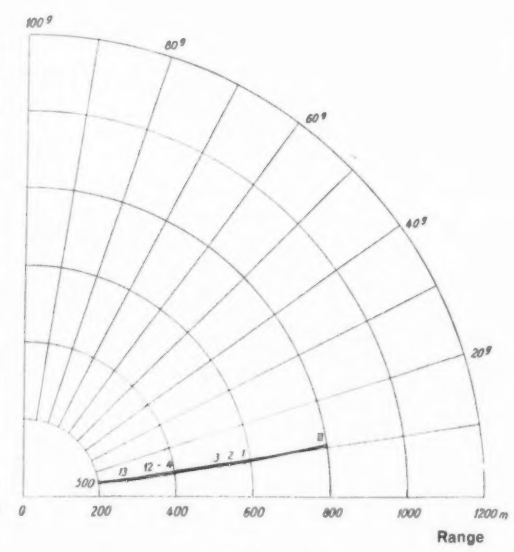
a) the 20-mm.-calibre gun must in theory have five times the rate of fire of the 30-mm.-calibre type, or twenty times the firing rate

* Continued from " Interavia, Review of World Aviation, " Vol. III, No. 2, p. 96-98.

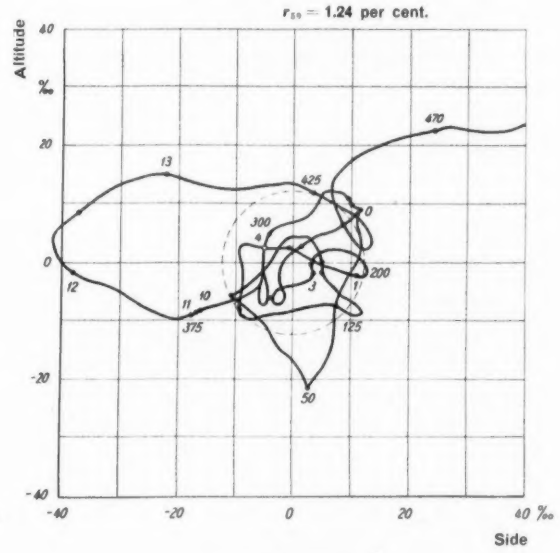
[2] According to the latest researches by Fuchs and Kottas (cf. " Interavia Review " No. 1, January, 1948, P. 38-42 — " Assessing the Efficacy of Aeroplane Armament ") 6.7 hits are necessary for destruction if the calibre is 30 mm. Meanwhile, the purpose of this article warrants the use of the figure dating from wartime results (4 hits).



Range



Flight angle

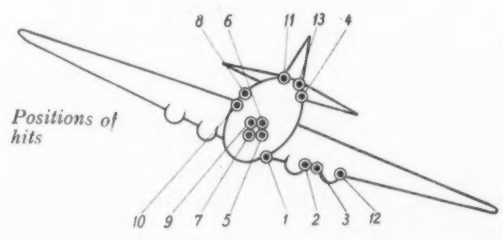


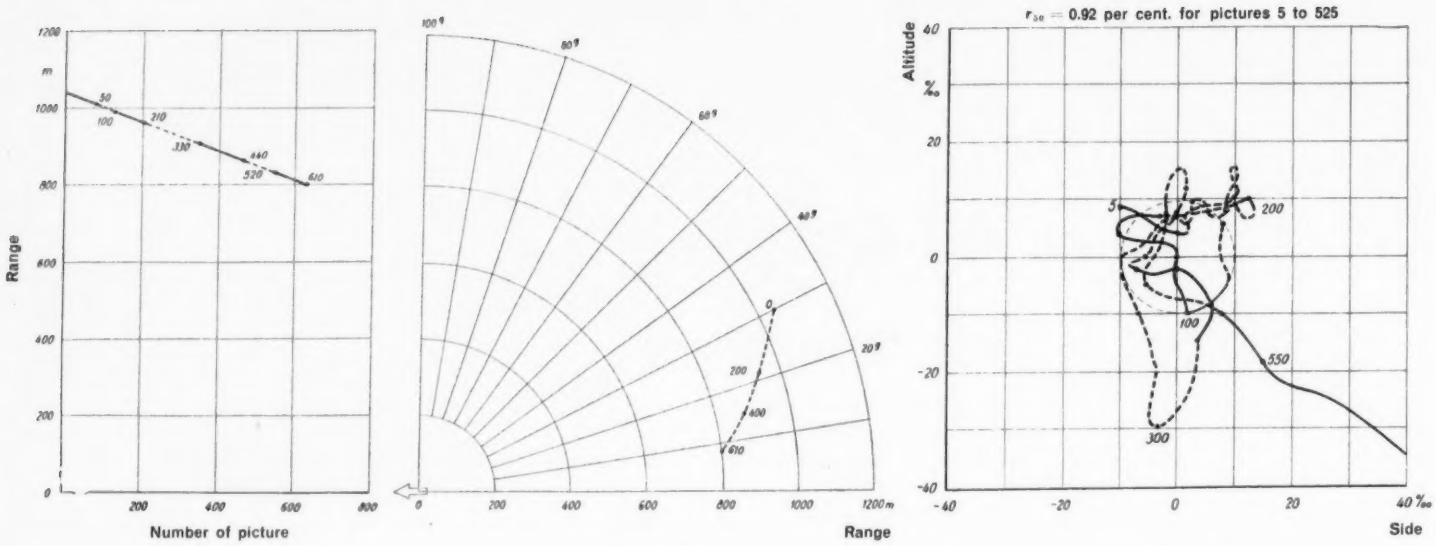
Firing dispersion

Fig. 3a: Cine-gun evaluation

Me 110 with 4 MG 151/20 and 2 MG 17 machine guns without automatic sights.

First case : Good possibility of success. Medium range (400 metres) at small flight angles (average gunner). The numbers from 1 to 13 refer to the hits and the others (0 and 50 to 500) to the pictures on the cine-gun film.





Range *Flight angle* *Firing dispersion*

Fig. 3 b ; Cine-Gun evaluation

Me 110 with 4 MG 151/20 and 2 MG 17 machine guns without automatic sights.

Second case : No possibility of success. Flight angle too large (skilled gunner). Numbers from 0 to 610 refer to the cine-gun pictures.

No hit

of the 55-mm.-calibre gun, to produce the same results ;

b) since the muzzle velocity of the projectile (v_o) only produces a certain amount of improvement in the firing dispersion (which does not enter into this discussion), whilst an increase in v_o is found to cause the rate of fire to decrease remarkably, increasing v_o will not entail an appreciable increase in the probability of destruction.

If destruction is required in a *shorter time* or from a *greater distance* than heretofore, whether in order to reduce the risk to one's own machine or because it is necessitated by the fact that one's own speed is greater than that of the enemy aeroplane, it can only be accomplished in practice by *augmenting the rate of fire.*

With regard to the firing dispersion it should be mentioned in conclusion that, in the case of singly-aimed shots, one may calculate with about half of its value as opposed to constant fire. However, further practical proof is needed here.

Lead dispersion (V_{50}) : It is assumed here, as was shown by the evaluation of German cine-gun films taken up to January, 1945, that at flight-path angles of more than 20 degrees destruction is hardly to be expected unless, of course, a sighting device is used which automatically computes the correct lead.

The first measure to diminish lead dispersion would be to keep the velocity of the projectiles low ; which means an increase of v_o. If the calibre remains the same, however, an increase of the weight of the gun is involved on the one hand, and a decrease in the rate of fire on the other. Furthermore, if the structural weight or space is fixed from the start, it would be necessary to reduce the quantity of ammunition taken on board. Logically, a reduction obtained in this way would be to the detriment of the probability of destruction.

For the purpose of comparison, the German MK 103 (calibre 30 mm.), which has a high v_o, and the MK 108 or MG 213/30 (both 30-mm-calibre but with much lower v_o) are taken as examples. The weight of the MK 103 is 140 kgs. and that of the MG 213/30, 75 kgs. In the same order the rates of fire are 400, 600 and 1,150 rounds per minute. If we confine ourselves at first to comparing the weights, it can be said that instead of one MK 103 either two MK 108 automatic cannon, or two MG 213/30 machine guns could be used, since their combined weight would not exceed that of the MK 103. Now, with the weights being about equal, the rate of fire of the two MK 108's would be treble, and that of the two MG 213/30's, 5½-times that of one MK 103. As will be seen later the statement is justified that—provided sufficient efficacy is assured—armament with higher rate of fire signifies a greater probability of destruction than armament with a lower rate of fire.

The above example illustrates clearly, in my opinion, that increasing the v_o is not the best way in which to improve the lead dispersion in order thereby to raise the probability of destruction. On the contrary, as a result of the diminished rate of fire, the results must necessarily suffer considerably. As a matter of fact, when firing with an automatic sighting device there is, in theory, no lead dispersion. Under this assumption, therefore, the v_o is no longer of interest to the subject under discussion.

The second possibility of reducing the lead dispersion to a minimum consists, as already mentioned, of having an automatic sighting device compute the lead automatically.

Supposing this to be the case, a target can in theory be fired on from any direction with a reasonable chance of success ; but in practice there are also certain limits to this case, which we need not amplify further.

When attacking at wide flight-path angles, the attacker is confronted by larger silhouettes than when flying at narrow angles. When attacking at an angle of 30 deg., for instance, either from above or below, the target area presented by a bomber is three times as great as when it is approached from the front or the back. This favourable circumstance cannot be sufficiently exploited, however, as the great amount of lead necessary can only be estimated correctly in the rarest cases, unless it happens to be computed by an automatic device. This particularly stresses the significance of a sighting device capable of automatically calculating the lead—since it opens up new and important vistas to the tactics of attacking.

V. Influence of muzzle velocity (v_o) and rate of fire (n) on destructive probability (W).

Although this question has already been touched upon, its importance warrants a special paragraph.

While comparing the MK 103 and MK 108 automatic cannon, figures 4 and 5 show v_o and n for a given firing dispersion (r_{50}),

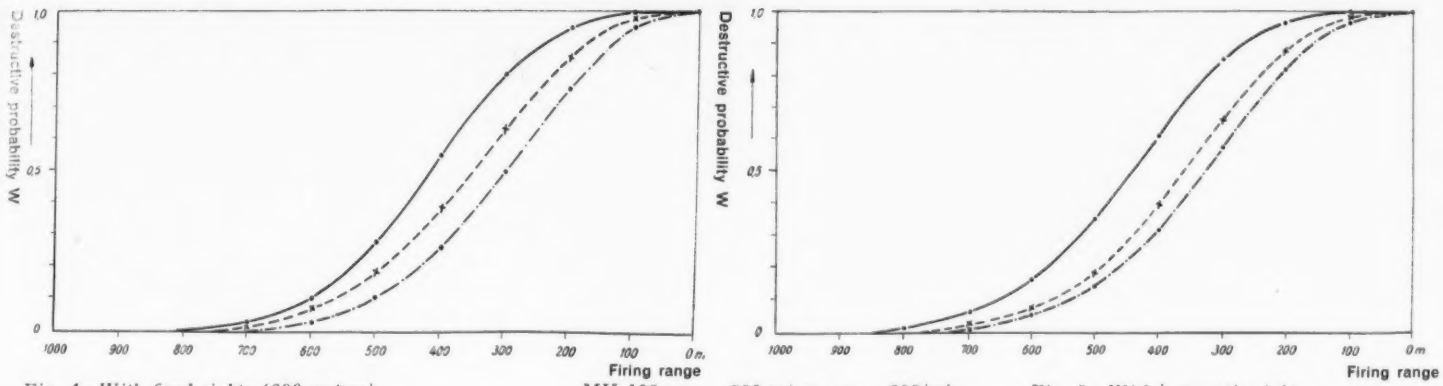


Fig. 4 : With fixed sights (600 metres)

MK 108 : v_o = 500 m/sec. ; n = 600/min.
MK 103 : v_o = 860 m/sec. ; n = 400/min.
MK 108 : v_o = 500 m/sec. ; n = 400/min.

Fig. 5 : With automatic sights.

High-performance fighter versus four-engined bomber

Comparison between MK 103 and MK 108 cannon : influence of v_o and rate of fire n. Destructive probability W as a function of the firing range. Approach angle = 0 deg. ; firing dispersion r_{50} = 1 per cent. ; constant fire opened at 1,000 metres.

plotted against W. In both figures the flight-path angle amounts to 0 deg. from the rear., and r_{50} was assumed to be 1 per cent. (in the sense of our definition as radius in percentage of the range) for a skilled gunner.

The experiment was carried out with both fixed sights (adjusted to 600 metres) and with an exact (automatic) sighting apparatus.

The full-line curve applies to an MK 108 cannon with a rate of fire of 600 rounds per minute and a v_o of 500 m/sec., the dotted curve to an MK 103 with a rate of fire of 400 rounds per minute and a v_o of 860 m/sec. The dot-dash curve refers to the MK 108 with its reduced rate of fire of 400 rounds per minute, v_o being constant.

In both the cases the result for the MK 108 with the reduced rate of fire is the poorest, that is to say, W is lowest. This supports the assertion we have already made that the *rate of fire is the most decisive factor* as regards destructive probability.

Furthermore, it can be seen from figures 4 and 5 that, in principle, with W remaining constant, it is possible to attack from a greater distance with a gun of high firing rate than with one of lesser rate of fire. In any case, a higher rate of fire n (assuming adequate efficacy) signifies less risk to one's own aeroplane.

The v_o, on the other hand, assuming constant destructive probability W, *cannot* be regarded as a means of increasing the attacking range.

In this connection I should like to refer again to my previous observation that in the case of singly-aimed shots one must reckon with about half the firing dispersion of that occurring in constant fire. This touches on quite a different principle of aerial gunnery. Shooting with a spray of shots, such as we are discussing here, is a requisite of rapid firing armament and is the extreme opposite of the accurately-aimed single shot. The latter therefore requires separate consideration.

Since high-penetration performance can be dispensed with for airborne targets, upon which fact I have still to enlarge, in this respect v_o does not gain in importance with regard to the destructive probability. Against ground objectives, however, it will all the same play a certain part.

The curves shown in figure 6[3] illustrate the interdependence of W and n.

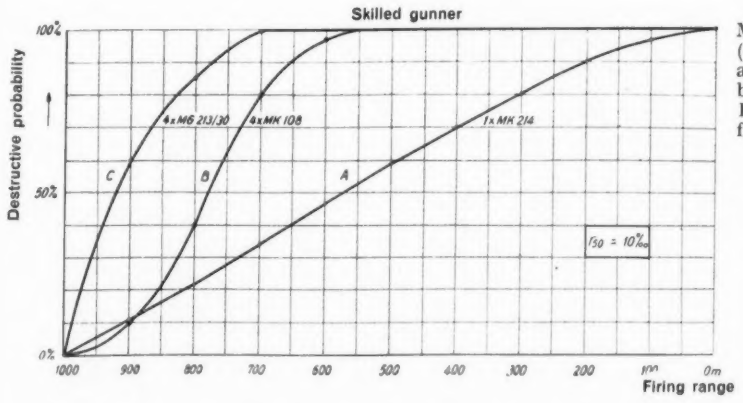
It represents an attack by a Messerschmitt 262 travelling at 200 m/sec. on a bomber with a speed of 100 m/sec. The attack takes place under 0 deg. from the rear, fire being opened at a range of 1,000 metres. In these circumstances W was investigated for three different but characteristic types of armament, for a skilled gunner, with the firing dispersion equal to 1 per cent.

It was furthermore assumed that W attained 100 per cent. with one hit with a 50-mm. shell or 4 hits with a 30-mm. shell.

The diagram gives further emphasis to the fact that n is the decisive factor for W.

It should again be stressed that the weight of the gun augments if the calibre and the v_o are increased, and also that the weight of the ammunition used per second is much greater if n increases. The proportionate

[3] Figure 6 originates from the Luftfahrtforschungsanstalt Braunschweig (LFA). The curves are only accurate for the case involved. The same applies to figure 8.



Me 262 (speed, 200 m/sec.) attacks a four-engined bomber (speed, 100 m/sec.) directly from the rear.

Fig. 6 : Destructive probability with different armament combinations

Armament	Calibre (mm.)	v_o (m/sec.)	Rate of fire (per min.)	Weight of gun (kgs.)	Weight of ammunition including belt for 1-sec. firing (kgs.)
"A" MK 214 A	50	920	150	480	12.5
"B" 4 MK 108's	30	600	4 × 600	240	22.8
"C" 4 MG 213/30's	30	550	4 × 1,150	300	42.2

Number of hits necessary with high-explosive ammunition of 50-mm. calibre : 1 hit ; calibre of 30 mm. : 4 hits. Constant fire opened at 1,000 metres.

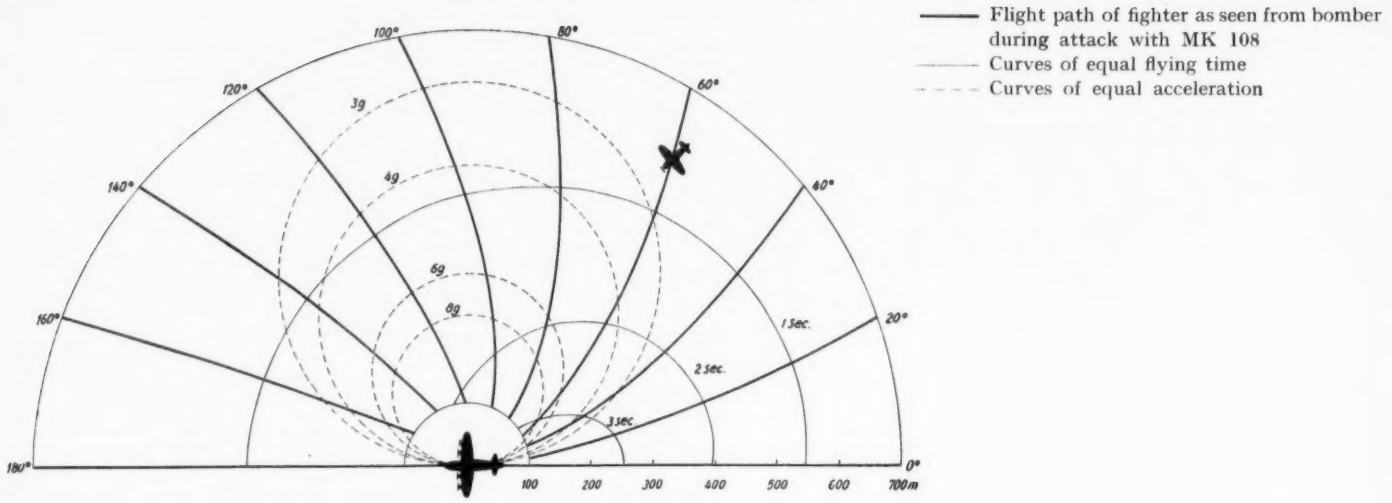


Fig. 7: Pursuit curves in an attack on a bomber (speed, 100 m/sec.) by a high-performance fighter (speed, 250 m/sec.) equipped with an automatic sighting device.

weight of explosive in the ammunition used per second is also much greater in case "C" than in case "A." In this connection, therefore, W for the "B" and "C" armament combinations must be much higher than for "A" at any given range.

It is fairly easy to see in what relation attacking ranges of these three types of armament stand to each other when W is constant. The most efficacious armament is that with the highest rate of fire.

Although the very much out-of-date MK 214 A was chosen to make the comparison seem especially sharp, it may be said that comparison with the modern 55-mm. MK 112 aeroplane cannon would not have produced any basically-different results.

VI. Acceleration conditions in attack flight; their effect on firing.

In practice it is not always possible to avoid wide attack angles. For instance, it is necessary if one's own aeroplane is substantially faster than that of the enemy. When *attacking from the flank*, the method which we are discussing here, the attacker is forced to go into a curve after spotting his opponent. While he is tracing this attack curve, the firing angle he will have to use is being steadily reduced. If both the attacking aeroplane and the opponent's machine have the same speed, the former has as much time as he likes to wait for his firing angle to diminish to the desired size. In the other case, where the attacker's aeroplane is decidedly faster than that of his enemy, so that he will soon catch up with his target, he has no choice but to begin firing very soon, in other words at a moment allowing only for much larger firing angles.

As can be seen in Fig. 7 the acceleration occurring in the pursuit curve increases as the enemy objective is approached. The greater the angle of approach, the sooner accelerations are reached which, for physiological reasons, make it impossible to aim. Accordingly, in the event of *wide approach angles* the attacker is compelled to fire from a *distance increasing* in proportion to these angles. If, therefore, very wide angles of approach are attained, a range is soon reached at which the chance of a hit it practically nil.

These conditions become the more strikingly apparent as the attacker's superiority in speed over his enemy increases. Fig. 7 shows the relations when the attacker's speed is 250 metres per second and that of the enemy 100 metres per second. The thick curves represent the attacker's flight path as seen from the target. The dotted circles signify lines of equal acceleration and the thin curves, lines of equal flying time.

As can be seen from Fig. 7, the high-speed attacker, approaching at 700 metres from the target at an angle of 45 deg. from the flank, already reaches the critical acceleration range, which we will assume here somewhat arbitrarily to be 4 g after 2.5 seconds' flying, and near the target reaches accelerations in the vicinity of 6 g.

Taking into account the accelerations which occur, it is obvious that an aeroplane closing in at low speed can conduct the attack at a distance much closer to the target than an aircraft flying fast.

(To be concluded next month)

The Pellenc Report

The Pellenc Report, a Parliamentary document of over 300 pages, in its "official, green cover."

The French "Journal Officiel" of 25th February, 1947, published a decree "appointing a Government Commissioner to study the conditions under which the nationalised aircraft manufacturing companies (Sociétés Nationales de Constructions Aéronautiques) were working in France."

The Commissioner was Inspector-General Pellenc, originally from the Post Office Administration, who was instructed to provide the responsible Ministries with a report and a plan of reorganisation within a month. This period was subsequently

The man entrusted with the task of reorganising the nationalised French aviation companies : *André Maroselli*, Secretary of State for the Air Force, officiating as Air Minister.

prolonged and now the Pellenc Report has been submitted to the French Parliament. It is a comprehensive document of some 300 pages, bound in the characteristic green of French officialdom.

In spite of the confidential nature of this report the French press managed to obtain extracts from it, and the newspapers either approved or condemned Mr. Pellenc's work, according to their political leanings and their attitude towards the system of nationalisation.

Comment on some of the aspects of the Pellenc Report would be uncalled for ; it is quite sufficient to give an impartial account of its contents and of the reaction it evoked in the French aircraft industry.

* * *

In January, 1945, *Charles Tillon*, Air Minister at the time, forced the Presidents of the four State aircraft works to resign.

First it should be remembered that the French nationalised aircraft companies, or *Sociétés Nationales de Constructions Aéronautiques*, abbreviated to SNCA, combine both private and national interests but are almost entirely financed by State capital. They were established by a law of 11th August, 1936, concerning the manufacture of war material. This nationalisation met with a certain amount of criticism, but the State companies seemed to be working satisfactorily till it was revealed in the debate on the Extraordinary Budget for 1947 that SNCA du Sud-Est was asking for an advance of 600 million francs from the French Treasury.

Two Members of Parliament, Jean Moreau and P. Meunier, were then instructed to examine the conditions prevailing in this company and in particular the business methods of its President and Managing Director, Deprez, who "resigned" in July, 1946.

Contents of the Pellenc Report

First of all the report gives a general survey of French aircraft manufacture in all its branches : industry, official organisations and nationalised companies. After briefly calling to mind that in June, 1940, the aircraft industry employed a total of 250,000 persons in France, and that the factory space covered an area of twenty-seven million square feet, Mr. Pellenc then draws attention to the considerable destruction and plundering which took place during the Occupation : a third of the

Mr. Pissavy, President of SNCA du Nord.

factory buildings were destroyed, 20 per cent. of the machinery was seized, and a great part of the personnel was dispersed.

Immediately after the Liberation the concerns were reorganised and the personnel was reassembled in order to fulfil the most urgent tasks in the remaining period of the War and to prepare for the peace lying ahead.

The nationalisation of the *engine industry* began in May, 1946, when the shares of the Gnome & Rhône company were taken over by the Government. On 1st January, 1846, the Billancourt works, which was formerly the Renault aero-engine concern, was amalgamated with *SNECMA (Société Nationale d'Etude et de Construction de Moteurs d'Aviation)*.

The regional arrangement of the nationalised industry then assumed the following form :

Mr. Avenet, President of SNCA du Sud-Ouest.

SNCA du Centre : factories at Issy, Billancourt, Colombes, Bourges, Fourchambaud and Chateauroux.

SNCA du Nord : factories at Meaulte, Le Havre, Caudebec, Les Mureaux, Sartrouville, Issy-les-Moulineaux and Choisy-le-Roi.

SNCA du Sud-Est : factories at Paris, Toulouse, Marignane and Cannes.

SNCA du Sud-Ouest : factories at Suresnes, Courbevois, Nantes, Saint-Nazaire, Rochefort and Bordeaux.

Mr. Bloch, President of SNCA du Centre.

The factory space covered by these different airframe manufacturing concerns amounted to over eight million square feet, while the engine factories in Paris, Billancourt, Argenteuil, Gennevilliers and Arnage had total area of over two million square feet at their disposal.

Staff was distributed among the different regions as follows :

SNCA du Sud-Ouest . . .	10,385
SNCA du Centre	10,708
SNCA du Nord	10,607
SNCA du Sud-Est	8,509
SNECMA	17,167

A total of 58,000 were employed in the nationalised concerns, compared with a total staff of 92,000 in the entire French aircraft manufacturing industry.

Mr. Hereil, President and Managing-Director of SNCA du Sud-Est.

Politics and Aviation

In 1944, after the Liberation, it was important to maintain a nucleus of skilled workers and protect tens of thousands from the risk of unemployment. It was therefore decided to complete the serial production of aircraft ordered by the Germans, although it was open to discussion whether these machines would

ever be of practical utility. At the same time, while awaiting the establishment of a new programme, a temporary conversion of the industry was envisaged. This meant that the SNCA concerns were to be given manufacturing contracts for non-aeronautical commodities, in order that they could keep their workers employed.

This seems the right place to quote the Pellenc Report literally :

> "... The War is over. There has been time to formulate ideas with regard to aircraft-manufacturing programmes and the production to be demanded of the industry. The conversion of manufacturing facilities and the reduction of personnel could therefore have been taken in hand.
>
> "But at this moment there appears to be an evolution in the sphere of economic and social conceptions. Varying trends of thought are being manifested ; their advocates differ as to how public affairs should be conducted, and each one, in his own particular sphere of action or of influence, is endeavouring to convert his personal convictions into deeds.
>
> "At this very moment a spate of nationalisation is pouring over the country. In Parliament, in the press and among the public, opinions are sometimes apt to clash very sharply.

President and Managing-Director of the SNECMA (Société Nationale d'Etude et de Construction de Moteurs d'Aviation), *Albert Weill* took over the engine industry in a "critical state."

"Nationalised factories have existed in the aeronautical industry for the last ten years. This fact should answer the question whether they give the workers substantial advantages and are of indisputable value to the public.

"With regard to the workers in nationalised industries it was impossible to begin by dismissing the fraction which exceeded requirements ; so they were retained. This, however, has involved the companies in considerable expense, without anything to offset it ; so that the State must endeavour to relieve them with considerable subsidies ..."

"... In order to show, on the other hand, the advantages which can be derived from nationalisation, every means has been tried to raise production : it must be admitted that both managers had workers have spared no efforts in this direction. Indeed a real 'cult of production' has arisen.

"Unfortunately, since the aim was primarily to impress the public, a policy was adopted which was more spectacular than practical ...

"... Finally, in the heat of the battle for nationalisation, inevitable ideological exaggeration sometimes could not help but lead to exaggerated acts ... Thus politics penetrated into the management of these nationalised concerns ; and it may be that sufficient consideration was not given to the implications of this almost unavoidable process."

In January, 1945, Mr. Charles Tillon, who was Air Minister at the time, summoned the Presidents of the four nationalised airframe manufacturing concerns, and compelled them to resign.

Their successors were Avenet (Sud-Ouest), Deprez (Sud-Est), Pissavy (Nord) and Bloch (Centre). It was also decreed that two Presidents of the other three State companies be elected to the Boards of the two remaining nationalised concerns.

Mr. Pellenc goes on to say that the Minister was doubtlessly convinced of the first-class abilities of these men, and had perhaps wished to concentrate the management of the entire aircraft industry in their hands.

> "But however sterling their abilities may have been," Mr. Pellenc continues, "it is not very clear how each one of them could have taken an active part in the affairs of three or four companies as important as these nationalised concerns."

Mr. Pellenc maintains that a general reduction in staff ought to have been carried out and that the SNCA's wages policy (unlimited production bonuses and unjustifiable raising of salary gradation) has led to a heavy financial burden being placed upon the State."

These charges are levelled in particular against the President and Managing-Director of SNCA du Sud-Est, Mr. Deprez, in whose company "disastrous conditions" are said to have prevailed.

Nord 2100, twin-engined passenger transport with pusher airscrews.

Comments on a Report from the "Services Officiels"

Mr. Pellenc goes on to discuss a Note handed to Minister Maroselli by the "Services Officiels." The opinions stated therein on the management of the State concerns deserve attention :

> "... *SNCA du Nord :* excellent organisation both industrially and financially, perhaps a little heavy but very efficient. The factories belonging to this company combine, in general, good results with low rates of pay.
>
> *SNCA du Sud-Ouest :* organisation much improved by the Managing-Director, whose high-class technical planning department has greatly furthered the firm's serial production activities. Results will be profitable, even if irregular : excellent for Nantes and Saint-Nazaire, medium for the Paris and Rochefort areas, and thoroughly bad in Bordeaux, where wages and bonuses are much too high.
>
> *SNCA du Centre :* general organisation satisfactory, except for the management of the production department, which is still inferior. Special attention ought to be paid to excessive bonuses and abnormally high hour-rates in the factories of this company. Unless the output is extremely good this can only result in a heavy deficit.
>
> *SNCA du Sud-Est :* a great effort has been made since September, 1946, by the new President and Managing-Director, Mr. Hereil, to recover from an absolutely disastrous situation. Substantial results have been attained but the hourly wage rates are still very high. The "Direction

SE 1010, four-engined high-altitude aircraft developed by SNCA du Sud-Est, intended as an experimental photo-reconnaissance aircraft. The prototype, shown here during the final assembly stage, is now ready for its flight tests.

Technique et Industrielle de l'Aéronautique" is still hopeful, but should Mr. Hereil fail, they cannot see any other solution than the closing down of the factories and the liquidation or bankruptcy of the company.

SNECMA : a great organisation drive in all departments has been carried out by Mr. Weill, the President and Managing Director, the results of which are appreciable. Difficulties were encountered at first, but an interim balance sheet, dated 1st October, 1946, and recently published, shows that accounts balanced and that business was normally profitable. The least encouraging point is the mediocre results obtained by the most important factory of the group, that in the Boulevard Kellermann (Paris). The abnormally high bonuses paid at the Argenteuil factory are being reduced.

"... The Government Commissioner, having seen the working of the national companies at first hand, is largely in agreement with the opinions thus expressed.

... But to stop at this estimate is not sufficient. The companies are working, but far from perfectly with regard to the administrative and financial aspects. They are working at high production costs. They pay their way, certainly, but this is because the State disbursements are in line with these high prices.

... At the same time, however, it must be recognised that, behind the scenes, real progressive work is being accomplished. If it is pursued with energy, efficiency and discipline, it could restore our standards of aeronautical production to modern international levels."

Pointing out, on the other hand, that delivery of serial products is seldom kept up to schedule, despite overstaffing, Mr. Pellenc gives the following reasons for this state of affairs :

Type modifications during serial production.
Inadequate synchronisation when work is shared out among several factories or companies.
Delays in the delivery of engines.
Delays in the delivery of equipment.

After severely criticising the former management of SNCA du Sud-Est and making an economic analysis of SNECMA, which he would like to see divided into at least two companies, Mr. Pellenc gives a recapitulative survey of the equipment manufactured between the Liberation and 31st December, 1946.

Prototype of the *Nord 1500* "Noréclair" torpedo aircraft, which made its first flight at the end of August, 1947.

"... 2,042 aeroplanes, certain of which are obsolete, and others unused, were produced by the nationalised factories during this period."

Mr. Pellenc makes the charge that quantity has been sacrificed in favour of quality. "Bad tactics" he concludes, "only creating the illusion of success instead of success itself—and at what a price !"

The Reorganisation Plan

The second part of the Pellenc Report is devoted to a scheme of rational planning for national aeronautical production.

First it is stated that unceasing research and development efforts are needed if a nation is to keep abreast of international competition. Budget reductions would inevitably lead to changes in the estimates of the individual companies and would jeopardise the future of the entire SNCA.

Even if the volume of orders were sufficient to guarantee a long-term activity for SNCA du Sud-Ouest and SNCA du Sud-Est, it seems that SNCA du Centre would still be faced by a bottleneck in a few months. This would have to be overcome by putting the Army's NC 211 four-engined cargo transport into production.

The volume of orders given to SNCA du Nord is also inadequate and should be remedied.

Action is needed and an overall plan for reorganising the aeronautical industry must be drawn up.

Here are Mr. Pellenc's proposals in rough outline :

Research must concentrate on : supplying large wind tunnels, aerodynamic studies on sonic speed, compressibility effects at sonic and supersonic speeds.

Gas-turbine engines and their problems in the domains of metallurgy, thermodynamics and mechanics.

Atmospheric problems (icing) and problems on which safe flying depends, such as the use of electronic aids to navigation (radar, etc.).

With regard to the industry itself, the planning departments must be kept busy. Prototypes must be constructed, especially in the domains of large flying-boats, remote-controlled equipment, jet engines and high-performance airscrew-turbines.

The report particularises several possibilities of remedying the defective organisation of the national companies :

A change in the composition of the Boards of Directors by introducing a majority of civil servants, together with increased cooperation by the Directors, who should only sit on two Boards at most. If the President of a company is at the same time its Managing-Director he can only sit on the Board of his own company. The Directors are to receive a proportionate share of the profits of their company, in recognition of their services and responsibility.

The creation of a Control Board *(Conseil de Surveillance)*, principally comprising civil servants selected from the staffs of the major State control organisations.

Finally, the creation of a coordinating committee, for examining all problems of common interest to the companies.

Nord 1200 "Norécrin," three-seater tourer developed by SNCA du Nord, is now in production.

SO 7050, two-seater tourer by SNCA du Sud-Ouest ; 75-H. P. Mathis engine.

SO 30R "Bellatrix," 30-passenger twin-engined medium-range transport now in French airline service. Developed by SNCA du Sud-Ouest.

SNCA du Sud-Ouest's *SO 90* short-range transport, largely used for mails, can carry 2,500 lbs. of payload.

SO 6000, two-seater jet aircraft developed by SNCA du Sud-Ouest, at present under test. (Note air intake beneath fuselage nose.) Test aeroplane for different jet engines and for converting pilots.

Changes of Staff ?

Will the intended reorganisation involve changes in the present managements of the nationalised companies ?

Mr. Pellenc is not in favour of this. He writes :

> "... A general change of management would not lead to any better understanding between the new chiefs and the people who have confidence in their present chiefs. It would provide no solution to the problem and might very well lead to friction at some later date.
>
> "... The Control Board would be in a position to ascertain whether the new managements were competent and whether conditions were making for effective employment and success. Until then, judgment should be reserved ..."

Criticising the Critic

At the end of his report Mr. Pellenc states that he has been at pains to achieve as much impartiality as possible in his enquiry. "No doubt," he says, "a large part of my report is taken up by criticism, but how could this be otherwise if the Government is to be as fully informed as possible ..."

This critical part of the Pellenc Report has, in its turn, been the object of violent attacks. The Government Commissioner, Inspector-General of the PTT, has been accused of insufficient knowledge of the special difficulties encountered by the aircraft industry. By giving a hearing to everyone, in his effort to attain impartiality, he is said to have made himself the mouthpiece of various personal, and usually political, resentments.

Furthermore, it must be said that Mr. Pellenc has refrained from any reference to economy and reorganisation measures which have frequently been carried out by different SNCA's with energy and positive results. For instance, it should be mentioned that at the end of 1947 SNCA du Sud-Ouest cut down their staff to 8,000 and were able to close their works in Bordeaux, in spite of easily comprehensible opposition.

It should likewise be pointed out that the delivery hold-ups, condemned by Mr. Pellenc, are not the responsibility of the aircraft industry but of the *Direction Technique et Industrielle,* who are also in charge of the selection of material, and of the General Staff of the French Air Force. Neither of these authorities completed its programme in time and, furthermore, demanded far too many modifications in the types under construction.

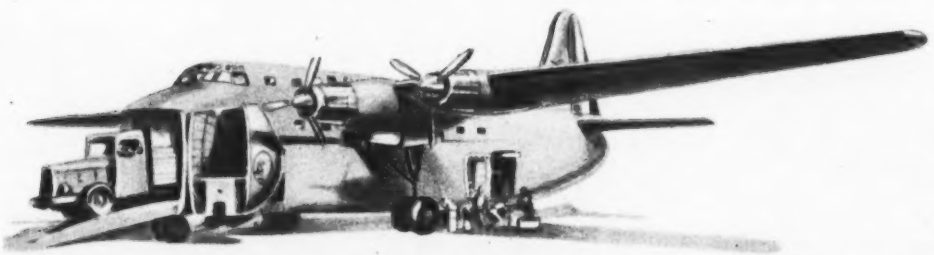
Another prominent reason for delays in delivery is said to lie in the difficulty of obtaining certain metals, particularly special kinds of steel. A State steelworks should have been created.

As far as engines are concerned, the inferior quality of the fuel and lubricants used since the Liberation had shortened their life.

The reorganisation plan is opposed on the ground that it would relegate the Managing-Directors to the status of an ordinary civil servant. A Managing-Director having to refer every detail to a control board and a coordinating committee would become an official without a sense of responsibility.

And one last accusation : it is unfortunate that Mr. Pellenc was not equipped with sufficient knowledge of aeronautics to appreciate the national companies' real achievements. In spite of the considerable time spent in the elaborate development, testing and alteration of prototypes, the French aircraft industry had put the following types into production in the period from August, 1944, to January, 1948 : Nord 1200, Nord 2100, Nord 1500, SO 90, SO 94, SO 30 N, SO 30 R, SO 6000, and so forth.

Opinions and counter-opinions have been given ample expression. The facts have been made public. Now the French Parliament must decide.



NC 211 "Cormoran," four-engined freighter, is ready for flight tests. Owing to withdrawal of production bonuses, workers of SNCA du Centre have hitherto prevented the aeroplane being taken to Toussus-le-Noble testing field.

Fighting for a Dutch Intercontinental Airport

On the 18th January, 1948, the Amsterdam Town Council granted additional credits totalling 19 million guilders for Schiphol Airport, Amsterdam, after about 50 million guilders had recently been spent on this installation. For the first time, a certain amount of opposition to the additional credit was manifested.

Actually, *Dr. Albert Plesman,* the President and Managing-Director of K.L.M. Royal Dutch Airlines, and the man who really created the national carrier, gave an address two days earlier to the Commercial High School in Rotterdam, in which he recommended the *construction of an intercontinental airport near Burgerveen in the Haarlemmermeer Polder.* This offended the local patriotism of the people of Amsterdam, who were afraid that Schiphol Airport would become of secondary importance and even be put out of business altogether by the future intercontinental airport in the Haarlemmermeer Polder—called H.M.P.-Zuid for short.

Even before the War, K.L.M. and Dr. Plesman were in favour of a project of this kind. Their ideas were as follows: the two big towns and trading centres, Amsterdam and Rotterdam, are only 34 miles apart. A joint airport for the two towns would thus be ideal. Originally, before the War, a joint airport of this kind was planned at Leiderdorp, but the softness of the ground, among other difficulties, prevented the carrying out of this scheme. Furthermore, both Amsterdam and Rotterdam had their own airports, though they were destroyed during the War. After the War the city of Amsterdam rebuilt Schiphol with great energy and at considerable expense, thus assisting the re-birth of Dutch civil aviation.

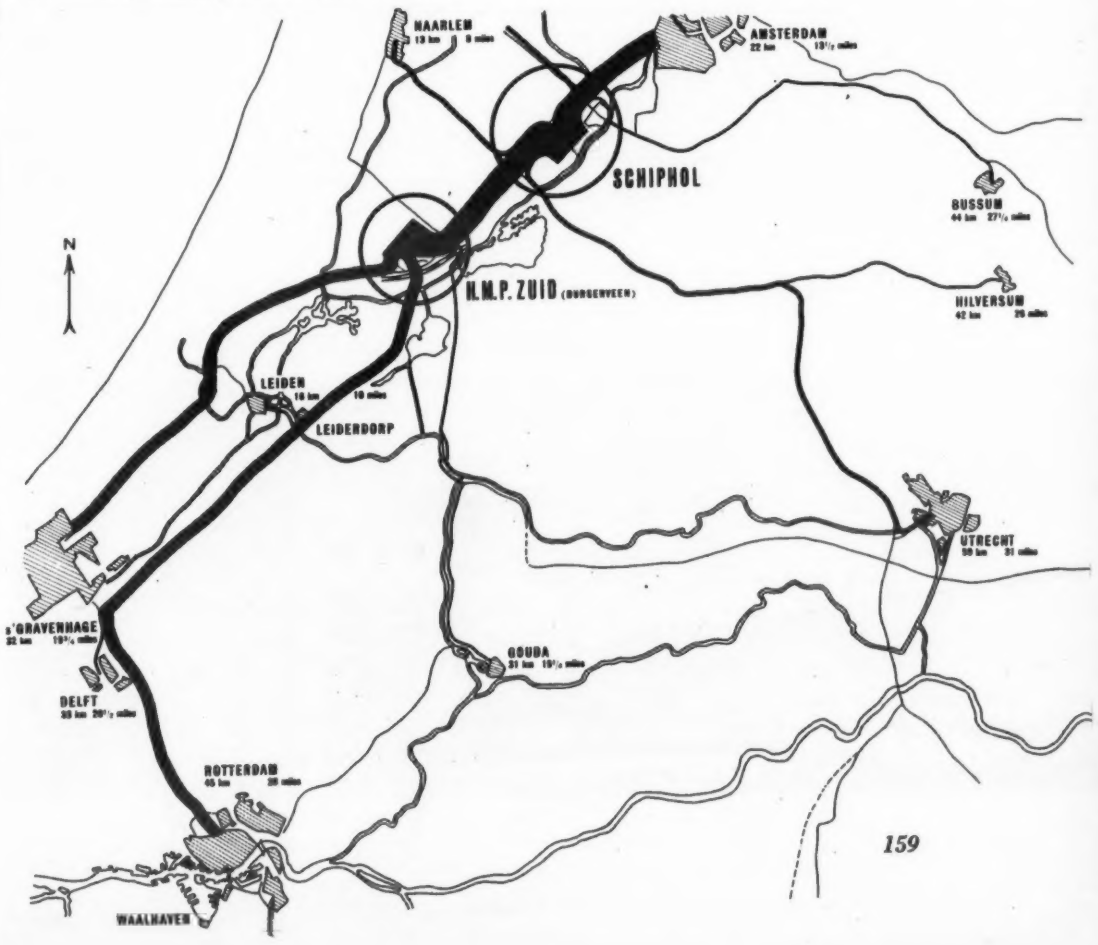
Meanwhile, however, Dr. Plesman estimates that a decentralisation of the Dutch airline business to several airports would be economically insupportable and to the detriment of future large-scale air transport. Schiphol, now reconstructed, is a Class B airport, according to ICAO standards, and can never be extended to the length of a Class A airport. The adjacent ground for a possible extension of the airport is partly too expensive, partly non-existent, partly unsuitable. On the other hand, Dr. Plesman has discovered that near Burgerveen, in the Haarlemmermeer Polder, a junction of the Dutch railway network is being prepared, where the lines from Amsterdam, Haarlem, the Hague, Delft, Rotterdam and Utrecht will meet. This, of course, would give vital importance to the construction of a Class A Dutch intercontinental airport at Burgerveen, near to this railway junction. Dr. Plesman and K.L.M. have also calculated that this would make it unnecessary to rebuild the Rotterdam airport and that money would be saved.

The opponents of this project in Amsterdam argue that if this were to happen their town would have been put to great and unnecessary expense and that, furthermore, the terrain in the Haarlemmermeer Polder is by no means central. The new intercontinental airport, H.M.P.-Zuid, would be only 7 miles south-west of Schiphol, 14 miles from Amsterdam, 20 miles from the Hague and 28 miles from Rotterdam. Rotterdam is at present about 35 miles from Schiphol, that is to say only 7 miles more.

Dr. Plesman, however, does not regard the question from a municipal but from a national point of view. He also considers that a Class A central intercontinental airport would not supplant the Amsterdam Class B airport, but only supplement it. Of course this would mean heavy expenditure on the part of the State, but something almost perfect would be created for the future, since the railway passenger service would be an ideal prerequisite in a flat and thickly-populated country like Holland. It should be added that the Haarlemmermeer Polder terrain is not absolutely first class from the agricultural point of view, so that the price of the ground would be reasonable. Plesman calculates that by constructing a uniform airport of this kind, an indirect saving on air, rail and postal traffic of about 150 million guilders would be effected.

The matter has been submitted to the Netherlands Government and they must decide whether the Class B airport of Schiphol is to be retained, whether a new airport can or should be built at Rotterdam, which at the best could only be a Class C airport involving further expenditure, or whether, in view of the importance of Dutch commercial aviation, a central airport should be constructed at Burgerveen in the Haarlemmermeer Polder.

K.L.M. has already announced that Schiphol can never become redundant, for it would be an alternate aerodrome, the centre of K.L.M.'s technical service, a practice airfield for their air crews, thus serving many other operational branches of aviation which do not belong to busy international airports.



Flying under the Sign of the Shamrock

Growing-Pains of the Irish Air Lines

I. Vickers — on two occasions.

It was on 14th July, 1919, that two Englishmen named Alcock and Brown took off from Newfoundland in a twin-engined Vickers "Vimy" and landed 16 hours and 12 minutes later at Clifden in the Irish County of Galway—the next parish to America, as the Irish call it.

Today everyone connected by profession or inclination with aviation knows : Were Ireland not part of the European land mass, then international transatlantic commercial aviation would have been forced to spare no expense in order to anchor this "aircraft-carrier" off the western shores of the Old World. Shannon Airport, on the river of the same name, fifteen miles west of the town of Limerick, with Rinéanna, the large airport for landplanes and, eight miles downstream, Foynes, the flying-boat harbour, are no more in need of publicity than Lloyds, Lake Lugano or the White House. The name Shannon is a household word in aviation.

Much less known to the general public is what this State with its exceptionally favourable geographical position, really contributes to air transport. The high-class ground organisation at Shannon puts the more modest home port of Irish civil aviation, Collinstown near Dublin, quite in the shade. The fleets of aeroplanes of many nations, landing and taking off at Shannon, make one forget the relatively small number of airliners which carry the Shamrock, Ireland's emblem, on short and medium stages over England, Scotland and the Continent.

But a report which recently appeared attracted general attention to Irish air transport again, and it may be recorded as a spicy little item of aviation history that in this news the name of Vickers also played a certain part :

Aerlinte Eireann will open its Atlantic route on 17th March, 1948, St. Patrick's Day.

Aer Lingus is disposing of its Vickers "Vikings" and will be the first European airline company to use four-engined "Constellations" on short routes.

What are Aerlinte Eireann and Aer Lingus ?

II. History and Structure of Irish Civil Air Transport.

Irish aviation was organised relatively late but then developed very quickly. In 1936 the Air Navigation and Transport Act was passed in the Dail, Ireland's Parliament.

The State airline founded on 22nd May, 1936, *Aer Lingus Teoranta,* was entrusted with the management of Irish air transportation and of *Collinstown Airport, near Dublin* (planned in 1936, begun in 1938 and completed in 1940).

At first there was some uncertainty in the public mind about the functions of another, also national, company, formed the following year and called *Aer Rianta Teoranta.* Nobody quite knew whether this company was to be regarded as "responsible for Irish air policy," as a "pure propaganda organisation" or as "a trustee of the Irish Government," or whether it would run civil aviation like Aer Lingus and also control the national airports. In any case this company kept at first in the background and left it to Aer Lingus to build up an Irish air route network.

* * *

On 27th May, 1936, a five-seater de Havilland D.H. 84 "Dragon" flew from Baldonnel to Bristol, thus opening Aer Lingus' operations. At that time the personnel of the firm totalled twelve. Four months later the increased traffic volume justified the purchase of a four-engined, fourteen-seater de Havilland D. H. 86 and on 14th September, 1936, the Dublin—Bristol—London passenger and mail service was opened, with one round trip every week-day. Later it was to become the chief route of Aer Lingus' European network.

There followed a steady, encouraging growth which is no different from that of other European companies and can be summed up in a few words :

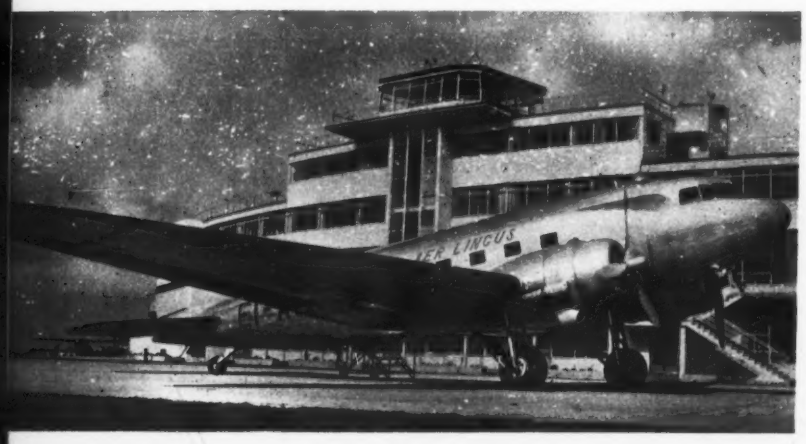
The number of passengers rose from 660 in 1936 to 3,814 in 1939, and in 1945 it rose to 19,103. In the Spring of 1940 the purchase was justified of the first fleet of Douglas DC-3's, with which services are flown in Ireland and to England. The airport at Collinstown proved a success. It is 215 feet above sea-level and therefore above the troublesome ground mists. It is only five miles from the centre of Dublin. Even the War did not interfere seriously with Irish air traffic, since Allied, and especially American, supply services were dependent on the north of the "Emerald Isle."

This ascent up to the end of the War is very similar to the development of commercial flying in many other small countries. It was not until 1946 that Ireland's civil aviation history began to show features of general interest.

III. "Quis separabit."

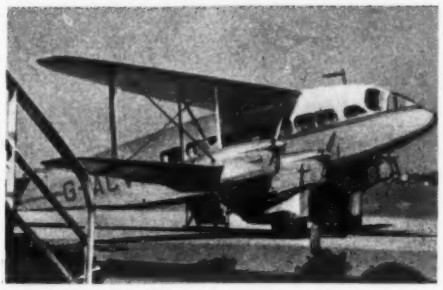
When George III founded the Order of St. Patrick —the highest Irish distinction—in 1783 he evidently did not expect the energy developed later by the Home Rule Movement, for he had the words "Quis separabit" engraved on the medallion. Well, as we know, they did separate in 1921, not without pains. But for the purposes of civil aviation they joined forces again in 1946, twenty-four years later, and have so far stayed together. Ireland and Great Britain are collaborating today within one of those interesting interstate air organisations, of which "Deruluft" was the only one

The home port of the Irish inland airlines. The Collinstown airport building with a Douglas DC-3 of Aer Lingus.



The Management of Aer Lingus off on an inspection trip of the company's network. Mr. J.F. Dempsey (left), General Manager, is being seen off by the Assistant General Manager, Major-General Michael Hogan.

In 1936 the first aeroplane which Aer Lingus put into service was this five-seater twin-engined de Havilland DH. 84 "Dragon."



By September, 1936, increased business justified the purchase of a 14-seater, four-engined de Havilland DH. 86.

The hall of Collinstown Airport, Dublin.

which existed before the last war, though since then others have arisen (SAS, TACA, Maszovlet).

England was somewhat concerned to see that Ireland was being courted by American civil aviation, and by that of other countries, on account of her central position. A number of air transport agreements (with the U. S. A., Sweden, France, and others), Ireland's importance in PICAO, which subsequently became the International Civil Aviation Organisation (Council Seat), the prominent position held by Aer Lingus in IATA, of which it was one of the founders, all point to the significance of the Free State in the world of aviation. This significance is emphasised by the circumstance that on certain Atlantic routes Shannon Airport must be used by practically all aircraft of all nations on their east- or westbound flights.

It is therefore not surprising that Great Britain has made efforts to combine British and Irish interests. On April 5th, 1946, a liberal aviation treaty was concluded by the two States. At the same time an agreement was made between BOAC, which had not yet been divided into three corporations, and Aer Rianta Teoranta. Now the real function of this Irish State enterprise, which had taken no part in practical aviation, became evident. At home it was the holding company for the whole of Irish air transport, and abroad it represented the civil aviation branch of Ireland's Department of Industry and Commerce, and held sixty per cent. of the shares of Aer Lingus, while BOAC were the holders of the remaining forty per cent. When British civil aviation split into the three corporations, BOAC, BEA and BSAA, British European Airways took over three-fourths of BOAC's holding in Aer Lingus. When this union was made, Aer Lingus received as a dowry what amounted to an operating monopoly for services between Ireland and England. West Coast Air Services gave up their routes in favour of Aer Lingus.

The annual report published by Aer Lingus at the end of December, 1947, for the year to 31st March, 1947, shows an increase of capital from £80,000 to £395,000. British European Airways took over 118,500 shares at par, Aer Rianta took 156,991, while the remaining 39,500 (ten per cent. of the capital) stayed in the hands of BOAC, enabling it to be represented on the Board of Aer Lingus.

Irish civil aviation itself completed its internal organisation by revising, in 1946, the Air Navigation and Transport Act of 1936 and by forming a third national aviation company, *Aer Linta Eireann Teoranta*, on March 1st, 1947, to which the operation of Ireland's trans-Atlantic services were entrusted.

The organisation plan of Irish commercial aviation is roughly outlined below.

IV. Growing-Pains of the Irish Air Lines.

If the history of Aer Lingus is similar to that of many other European airlines, its last yearly report (to 31st March, 1947) is also completely in line with the general tendency. *The balance ends with a substantial deficit.* When the Irish and British Directors of Aer Lingus met on Monday, January 12th, 1948, at Kildare Street, Dublin, for their eleventh annual meeting, the Chairman, John Leydon, Secretary of the Department of Industry & Commerce, gave them the following information. The gross revenue of Aer Lingus amounted to £377,345, which compares with £107,219 for 1945/46. At the same time the total operating costs rose from £95,325 to £516,821. The loss of £134,156 is no longer apparent in the profit and loss account as Aer Rianta, the parent company, had already contributed £57,500, or 60 per cent., and the modest profit of £8,566 made in the previous year could be deducted. Presumably the British corporations will also meet their obligations to the extent of 40 per cent. of the loss, very shortly (which they have done ; BEA and BOAC have paid £63,287—Ed.), whereby the deficit will be balanced on paper. This, however, could not satisfy the State-employed officials of the company. They have had to enquire into the economic reasons for this loss.

Operating results could surely not be made responsible, as is clear from the increase in revenue.

Aer Lingus can be content with the extent of its *route network :*

1. Dublin—London :	5 times daily in both directions
2. Dublin—Liverpool :	2 times daily in both directions
3. Dublin—Shannon :	17 times weekly in both directions
4. Dublin—Paris :	2 times weekly (Friday and Sunday) in both directions
5. Dublin—Belfast—Glasgow :	2 times daily on weekdays in both directions
6. Shannon—London :	3 times weekly (Mon., Wed. & Sat.) in both directions
7. Dublin—Manchester—Amsterdam : (jointly with KLM)	Aer Lingus flies Mon. and Thurs. in both directions
8. Dublin—Brussels :	1 weekly (Wednesday)
9. Dublin—Rome :	1 weekly (outward Wed., return Thurs.)
10. Dublin—Manchester :	2 times daily in both directions

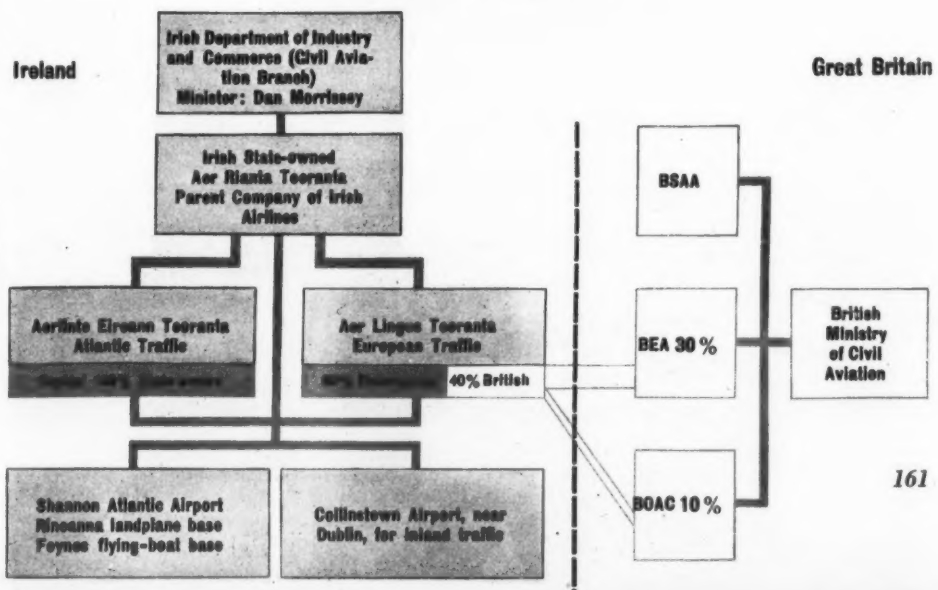
Projected Services :

Dublin—Oslo—Stockholm
Dublin—Paris—Geneva—Rome
Dublin—Bordeaux—Madrid
Dublin—Lisbon.

Freight and passenger traffic rose sharply compared with the previous year. Some 21,269 passengers were carried in September, 1947, alone : this is almost equal to the figure for the entire operating year 1945-46 (21,630). The following is a survey of the *operating results,* in so far as they have already been published.

The „General Staff" of the Irish airlines on the occasion of the arrival of Lockheed „Constallations" at Shannon Airport, in September, 1947. From left to right, foreground ; J.F. Demosey, General Manager of Aer Lingus ; Sean Leydon, Chairman of Aer Lingus ; Sean Lemass, Irish Minister of Industry & Commerce ; Capt. J.C. Kelly-Rogers, Technical Manager, Aer Linta Eireann ; and J.J. O'Leary, Director Aer Linta Eireann.

ANGLO-IRISH CIVIL AVIATION


Ireland
Great Britain
Irish Department of Industry and Commerce (Civil Aviation Branch) Minister: Dan Morrissey
Irish State-owned Aer Rianta Teoranta Parent Company of Irish Airlines
Aerlinte Eireann Teoranta Atlantic Traffic
Aer Lingus Teoranta European Traffic
40% British
Shannon Atlantic Airport Rineanna landplane base Foynes flying-boat base
Collinstown Airport, near Dublin, for inland traffic
BSAA
BEA 30 %
BOAC 10 %
British Ministry of Civil Aviation

Locked "Constellation 749's" belonging to the Irish trans-Atlantic company, Aer Linta Eireann, have arrived at Shannon Airport. Aer Lingus has hired aeroplanes of this type from Aer Linta Eireann and has been using them on the Dublin—London route since 3rd November, 1947.

	1945/46	1946/47	9 months 31. 3.-31. 12.47
Aircraft miles :	16,548,000	27,622,000	123,900,000
Passengers :	21,630	76,300	
	(1946)	(1947)	
Freight (lbs.) :	305,000	1,030,000	
Operating regularity :	95 %		
Load factor :	72 %		68 %

Reflecting these intensified operations, the personnel increased to a total of 1,800.

Hence it is evident that the operations recorded in the annual report were by no means unsatisfactory. Nor does the network of routes give the impression that the company had over-estimated its stamina and expanded too rapidly. *What then is the real reason for the debit balance?*

The Chairman of the company attributed it to three causes :

(1) "In connection with our revenue figures, I would emphasise that the proportion of our total revenue represented by what we earn on the *carriage of mails* is microscopic by comparison with the position of nearly every other airline in the world. This entails crippling financial expenses and I can only express the hope today that it will be remedied in the near future."

(2) "In order to meet expected commitments the company had to expand rapidly in all directions by *recruiting and training staff* and *securing the necessary accommodation.*"

(3) "We found ourselves confronted during the year (to 31st March, 1947) with a serious situation in regard to our fleet of DC-3 aircraft for which it became impossible to secure spares in adequate quantities... We decided to buy "Viking" aircraft to fill our needs and received delivery in the period June-September, 1947. In the middle of 1947, however, the picture changed... and it is now clear that the necessity for replacing the DC-3's does not immediately arise. We therefore found ourselves with more aircraft than our programme warranted, and in the circumstances the Board decided to rationalise our fleet position by disposing of the 'Viking' aircraft."

The first two reasons are self-explanatory, but what about the third ?

V. From "Viking" to "Constellation."

It is quite true that there was a bottleneck in the supply of spares for the Douglas DC-3 towards the end of the War. It is no less true that various airline companies were compelled to subscribe to the motto "anything with wings must fly." On the other hand, it is logical and reflects sound business principles, when such conditions no longer prevail, to rationalise flying and eliminate too great a diversity of type. And indeed the air fleet of Aer Lingus has been purged following the elimination of the seven "Vikings."

The fleet now consists of 8 Douglas DC-3 passenger and 2 DC-3 freighter aircraft, owned by Aer Lingus. Besides, an unspecified number of "Constellations" hired from Aerlinte Eireann are in use. Quite naturally, it is not certain how many "Constellations" the Irish trans-Atlantic airline will be able to spare after inaugurating its thrice-weekly Shannon—New York service.

Nevertheless, there are different ways of doing things. There is a difference, for instance, between disposing on a suitable occasion of surplus equipment that has become a liability, and getting rid of it promptly and without notice. The Vickers "Vikings" were taken off the Dublin—London route on January, 1948, and stored in hangars, without any announcement concerning the imminent completion of their sale. In his speech, the Chairman of the Board declared that the withdrawal of the "Vikings" would involve dismissing some of the staff. In effect, such dismissals have meanwhile taken place. Then it must be remembered that Aer Lingus now entends to use "Constellations" on the same route, has indeed been doing so since the beginning of November, 1947. From the Spring of 1948 the London—Dublin route will be flown *six times a day* in each direction with Lockheed "Constellation 749's" hired by Aer Lingus from Aerlinte Eireann. It might be thought that if there is enough work for four-engined 48-seater "Constellations," seven "Vikings" could earn their keep there as well.

The Aer Lingus annual report carefully avoids any invidious comment on the aircraft taken out of commission. It confines itself to the statement :

> "Our decision to standardise on DC-3 aircraft has been taken solely on commercial grounds after very careful consideration."

Meanwhile, Aer Lingus is flying, whether with "Vikings", DC-3's, or "Constellations 749's." And on next St. Patrick's Day the sister company, Aerlinte Eireann Teoranta, will join the grand concert of engines roaring across the Atlantic. *He.*

Route map of Aer Lingus.

One of the seven Vickers "Vikings" delivered to Aer Lingus in the middle of 1947, put out of commission at the end of the same year and now being disposed of.

Official Bulletin of the F.A.I.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS

Meeting of the Conseil Général of the F.A.I., Paris, 5th and 6th January, 1948

The Conseil Général of the Fédération Aéronautique Internationale met at Paris on 5th and 6th January, with Lord Brabazon of Tara, M.C., P.C., in the Chair.

The Aero Clubs of Belgium, Czechoslovakia, France, Great Britain, the Netherlands and Switzerland were represented. The Aero Clubs of Brazil, Egypt, Italy, the Principality of Monaco, Sweden and Turkey sent apologies for their non-attendance.

Examination of the Financial Situation

The new Treasurer General, M. Jacques Allez, gave delegates the results of the 1947 period and proceeded to analyse the balance sheet.

The Council considered reductions of expenditure and possibilities of increasing revenue. The membership fee has been increased and so have the prices of customs carnets and the fees for the homologation of records. The rates of payment are based on the exchange value of the Swiss franc on January 1st, 1948.

Admissions and Expulsions

The General Council notes with satisfaction the return to active membership of the F.A.I. of the Aero Club of the Polish Republic, as well as the pending reaffiliation of the Aero Club of Chile.

Federación Aeronáutica Nacional de España F.A.N.E.

As a result of a demand for the expulsion of this federation, made by the Central Aero Club of the U.S.S.R., the Council considers that it cannot recommend the General Conference to expel the F.A.N.E. The F.A.I. being a group of associations formed with aims pertaining purely to sport, it does not seem opportune to expel an aero club for reasons unconnected with sport. Furthermore, according to the statutes of the F.A.I., it is only the General Conference which can decide on this question, with a majority of two thirds of the votes.

Unione Triestina Aeromodellistica

The Secretary-General read a letter from the Unione Triestina Aeromodellisticia requesting admission to the F.A.I.

Official Language of the F.A.I.

The question of allowing Russian to be used as an official language of the F.A.I. has been taken up again by the General Council, which considers that the introduction of a new language into its meetings would make them longer and more complicated than is necessary, and has consequently decided not to recommend the adoption of a supplementary language. On the other hand, it authorises the translation of F.A.I. documents into Russian on the same conditions as the translation into English.

F.A.I. Gold Medal

Owing to certain difficulties in this respect, it was impossible to strike a Gold Medal in 1947. For this reason the Aero Clubs have not been invited to present a candidate for the award.

International Congress on African Touring

The Secretary-General gave an account of the work done in the course of this Congress in the domain of tourist aviation. At the request of the General Council the following wishes, expressed by the Aviation Commission of the Congress, are to be transmitted to the Commission Internationale du Tourisme Aérien of the F.A.I. :

1) that private aeroplanes may be equipped with radio transmitters and receivers weighing less than 20 kgs.
2) that an aeronautical chart on the scale of 1 : 1,000,000 should be prepared for the African Continent.
3) that the method of levying landing fees should be simplified, if possible, by the use of international coupons issued by official organisations.

International Gliding Competitions in 1948

The delegate of the Swiss Aero Club has informed the Council that his club is prepared to undertake the organisation of the competitions which will be held in the second half of July at Samaden, Switzerland. It requests that all the national aero clubs should let the Swiss Aero Club know, as soon as possible, the number of participants they intend sending. (There is a limit of four gliders and four pilots per country, the fees which competitors must pay being fixed at 200 Swiss francs per pilot, 100 Swiss francs for the first two assistants and 250 Swiss francs for supplementary assistants.)

Gordon Bennett Trophy for Balloons

The Secretary-General told the Council of the decision of the Aero Club of the Polish Republic not to organise the competition for this trophy in 1949. The delegate of the Belgian Aero Club confirmed his Aero Club's readiness to take charge of this organisation.

Prince George Bibesco Trophy

The Aero Club of France proposed a simplification of the special regulations for the first competition in 1949. The organisation of this competition on the lines of the "Challenge International de Tourisme Aérien" enforced before the War, would necessitate very considerable preparations and long and onerous tests both for the organising club and for the competitors. For the first year the competition would be limited to a speed test for aeroplanes conforming to the already prescribed minimum conditions of comfort and technical equipment.

On these principles the French Aero Club will draw up the special regulations for the trophy, which should be published, at the latest, on April 1st, 1948.

Olympic Games in 1952

The General Council has decided to ask the Olympic Games Committee to raise the question of amateur gliding pilots anew, with the object of allowing military and commercial pilots to take part in amateur competitions.

Aeronautical Calendar for 1948

The General Council has approved the Aeronautical Calendar for 1948, from which the following are extracts :

19th—31st July : F. A. I. International Gliding Competitions, organised at Samaden by the Swiss Aero Club.

7th & 8th August : Second Squadron Competition, organised by Vliegeld, Ypenburg N. V., Rijswijk ZH.

27th Aug.—25the Sept. : Tour de France by air, organised by the Association Française pour le Développement Aéronautique, under the patronage of the French Aero Club.

28th—29th August : International air races organised by the Cinque Ports Flying Club, Lympne Airport, Kent. (Subject to confirmation.)

Conferences in 1948

The Ordinary Conference of the F. A. I. will be held in Cleveland, Ohio, in September. Owing to the suppression of the Salon de l'Aviation, the Extraordinary Conference, which should take place in Paris next May, has been postponed to 6th-9th July, 1948.

Reorganisation of ISTUS

The Geneva Conference had entrusted the French Aero Club with the task of studying the reorganisation of an international committee for the scientific and technical study of gliding, in succession to ISTUS. M. Pierre Massenet explained the project elaborated in this connection, and asked whether it would be possible to take advantage of the international gliding competition in Switzerland next July, to hold at the same time a congress of gliding experts. The Swiss delegate accepted this proposition, requesting that the Swiss Aero Club should be informed as soon as possible of the programme of this congress.

With regard to the financing of the new organisation, the delegates present at the meeting of the General Council assured the President of the participation of their respective clubs.

Relations between the F.A.I. and ICAO

The General Council took note of a report by General B. J. Kwiecinski, Permanent Delegate of the F.A.I. to ICAO, concerning the forthcoming meeting in Europe of the F.A.I. section of ICAO. Different aspects of international air traffic will be studied at this meeting. It was pointed out to the Council that this would be an opportunity for the F.A.I. to put forward its views relative to the interests of private flying.

The General Council empowered the President of the F.A.I., Lord Brabazon of Tara, to establish contact with the Fedération Internationale de l'Automobile and the Alliance Internationale de Tourisme with a view to participation by F.A.I. in the common organisation created by the two associations for studying questions of interest to international touring.

Professor J. Ackeret, D. Sc., 50 Years Old

Professor Jakob Ackeret, D. Sc., Director of the Aerodynamics Department of the Swiss Institute of Technology at Zurich, will celebrate his 50th birthday on 17th March, 1948. He has been well-known for many years in professional circles as an eminent and farseeing research worker in the field of fluid mechanics. After obtaining an honours diploma in mechanical engineering at Zurich in 1920, he was first engaged as assistant to the steam- and gas-turbine expert, A. Stodola, but transferred in 1921 to Goettingen, where, as assistant to Professor Ludwig Prandtl, he made himself a name with his extensive research on aeroplane wings, in particular by publications on air forces on wings moving at supersonic speed ("Luftkräfte auf Flügel, die mit grösser als Schallgeschwindigkeit bewegt werden"—as early as 1925), boundary layer suction, and so forth. After returning to Switzerland in 1927 he became head of the fluid mechanics laboratory of the Escher Wyss Maschinenfabriken AG., Zurich, where, among other things, he has been able to adapt his knowledge gained in the study of aerodynamics to the construction of water turbines. He also took up teaching at the Institute of Technology. The creation of an Aerodynamics Department by the latter Institute offered him the opportunity of using his Goettingen experience to construct the Zurich wind tunnel, one of the first supersonic wind tunnels in Europe. In 1934 he was appointed Professor, which allowed him to make full use of his talent as a teacher. His pupils are grateful to him for the clarity and objectivity with which he conducts their study of aerodynamics. He has a lively style and a measure of foresight which continually leads to surprising applications of aerodynamic knowledge to new branches of the subject, proving that aerodynamic research, like any other pure research, is justified even in a small country not rich in aviation industry of its own.

Fact or Fancy?

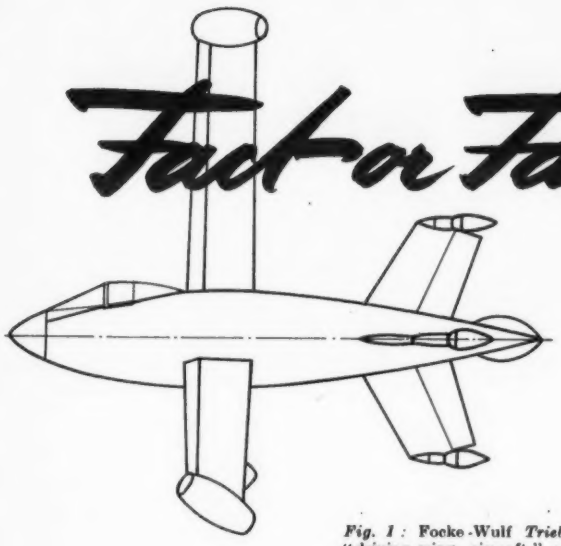
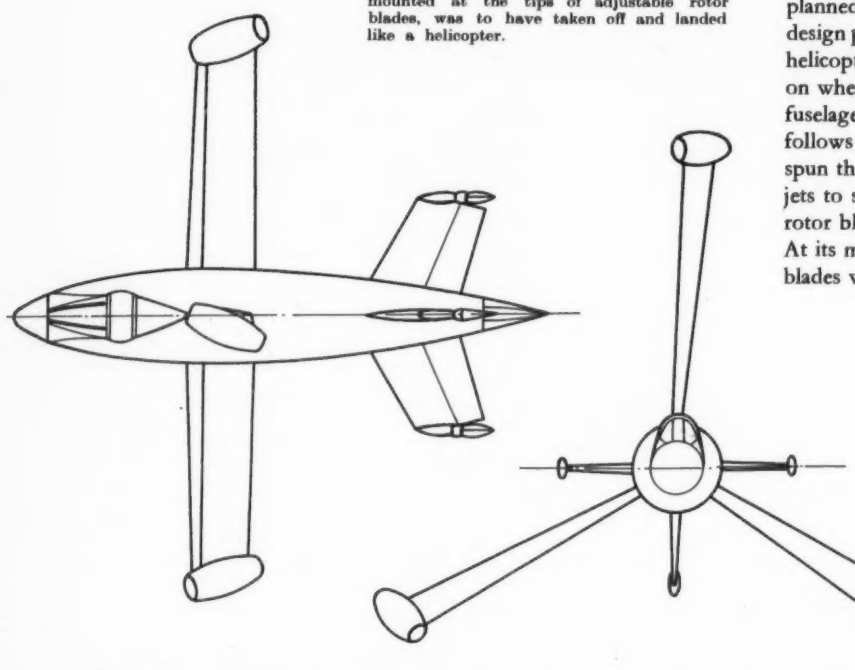


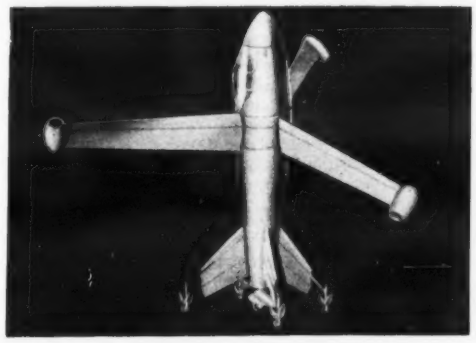
Fig. 1 : Focke-Wulf *Triebflügelflugzeug*, or "driving-wing aircraft," with ram-jet units mounted at the tips of adjustable rotor blades, was to have taken off and landed like a helicopter.



The Allied armies had hardly crossed the Rhine when British and American, Russian and French commissions of investigation started searching for and removing all the plans and documents stored in the research centres and design departments of the German aircraft manufacturing industry. Literally tons of documents were collected and an entire army of engineers is still engaged in examining them.

Apart from projects ready to go into production and destined to provide the Luftwaffe with new fighting equipment within a short time, the archives also contained blue prints of new aircraft which, at first sight, looked like creations of an undisciplined imagination. Although such designs could hardly be realised with the means available today, and can be assessed from many different angles with regard to their tactical value, they all the same serve to illustrate the path which German aircraft development was supposed to follow. Perhaps in the course of the next few years the conclusion will be reached that these designs, fantastic though they may appear today, are not entirely irrelevant after all.

It has long been the wish of every designer to combine the advantages of a helicopter with the characteristics of a high-speed jet-propelled aeroplane. The *Focke-Wulf-Flugzeugwerke* elaborated a project of this kind (Fig. 1), which they called a *Triebflügelflugzeug*, a "driving-wing aircraft." Here the wing unit is replaced by three rotating, adjustable rotor blades with ram-jet engines mounted at the tips. The fuselage planned for the "driving-wing aircraft" corresponds to conventional design practice, but the machine was to have taken off from the spot like a helicopter and was likewise intended to land vertically like a helicopter, on wheels which were to have been retractable into the tail part of the fuselage. The take-off was planned by the designers to take place as follows : Walter rocket units, installed inside the ram jets, were to have spun the rotor blades until the tip speed was great enough for the ram jets to start functioning ; by adjusting the angle of attack of the three rotor blades, the aircraft would rise from the ground like a helicopter. At its maximum speed, calculated at 620 m. p. h. at sea level, the rotor blades would rotate at about 220 r. p. m. (with a small angle of attack)



and the ram jet units at a speed rating of Mach 0.9. The following dimensions were foreseen : length, 30 feet ; rotor diameter, 35 feet 4 inches ; all-up weight, 11,380 lbs., of which 3,300 lbs. were to have been fuel ; rate of climb, 3,280 feet in 8 seconds.

When the first aircraft with sweptback wing were tested in Germany, their advantages were indeed realised, but also their unreliability in the landing. In search of a compromise the *Blohm & Voss* aircraft concern, in their *P-202* project (Fig. 2), proposed making the wing unit of a high-wing monoplane, with two jet engines mounted under the fuselage, rotatable in flight. The intention was to take off and land with an orthodox wing unit but at the same time, by giving the wing sweep-

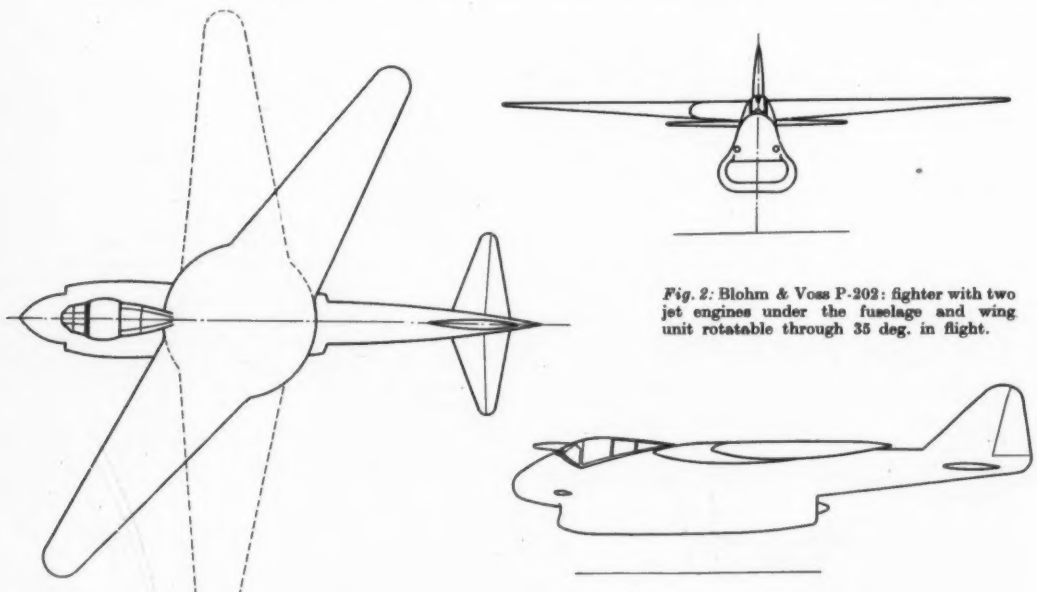


Fig. 2: Blohm & Voss P-202: fighter with two jet engines under the fuselage and wing unit rotatable through 35 deg. in flight.

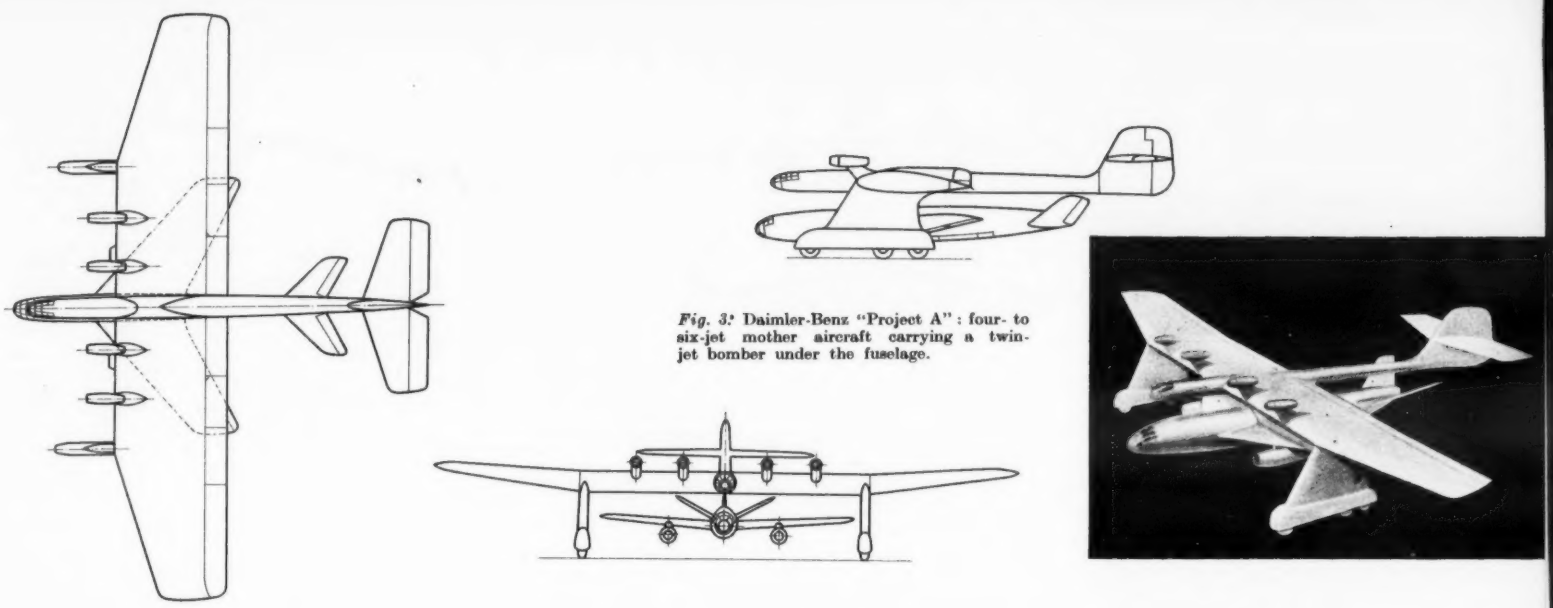


Fig. 3: Daimler-Benz "Project A": four- to six-jet mother aircraft carrying a twin-jet bomber under the fuselage.

back, to be able to delay the effects of compressibility at high speeds. At low speeds, therefore, the wing's lift-increasing equipment (slats and flaps) would have been effective, while at high speeds the leading edge would have formed an angle of 35 degrees with the direction of flight.

The combined use of a multi-engined mother aircraft and one or more short-range fighters is not a new idea, and was recently tested again in the U. S. A. In Germany it was the *Daimler-Benz* concern which, towards the end of the War, went in not only for the construction of the power plants but also for the entire design of such aircraft combinations. Fig. 3 shows a construction called *Project A,* in which a carrier equipped with four to six engines (Heinkel He S 021, a development of the He S 011 engine) carries a twin-jet fighter between the undercarriage struts (track width about 82 feet). The mother aircraft was to have had a span of 308 ft. 4 3/4 in. and a weight of about 50 tons (wing area 5,170 sq. ft.); and the following figures were given for the jet fighter: span, 75 ft. 11 3/4 in.; wing area, 1,560 sq. ft.; all-up weight, 72 tons, including 30 tons of bombs and 18 tons of fuel.

A similar plan, the *Daimler-Benz Project E,* was to comprise a carrier of the same kind, but with a double tail assembly and six DB 603 reciprocating engines, carrying five small jet aircraft slung beneath the fuselage (Fig. 4). These fighters were intended as expendable equipment and greatly resembled the V1 flying bomb. They were planned to span 25 ft. 6 1/8 in., weigh more than 10 tons all-up, and their maximum speed was calculated at 620 m. p. h.

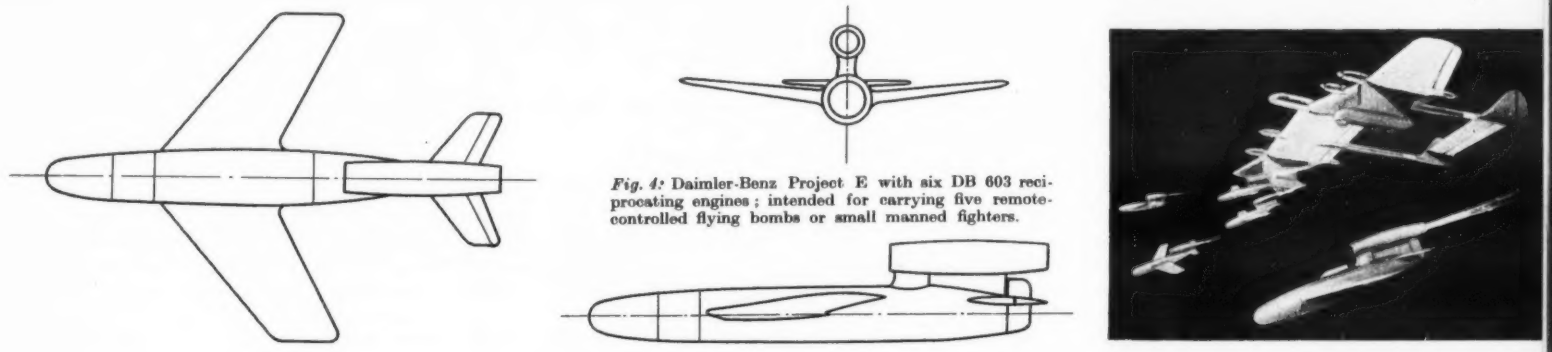


Fig. 4: Daimler-Benz Project E with six DB 603 reciprocating engines; intended for carrying five remote-controlled flying bombs or small manned fighters.

Instead of these small fighters, from which the pilot was to have bailed out just before attaining his target, the Project E carrier was also to have been capable of taking a jet-propelled bomber (Fig. 5), which was to have had a span of 72 ft. 2 1/4 in., an all-up weight of 70 tons, and a 620-mile range with 30 tons of military load.

This is only a small fraction of the many designs worked out by German aeronautical engineers, which fell into the hands of the Allied investigation commissions after the War. Most of them were never developed to the production stage, for one reason or another; but there can be no doubt that they offer suggestions and give certain hints with regard to the possibilities of further developing the Germans' last-stage flying equipment.

Bi.

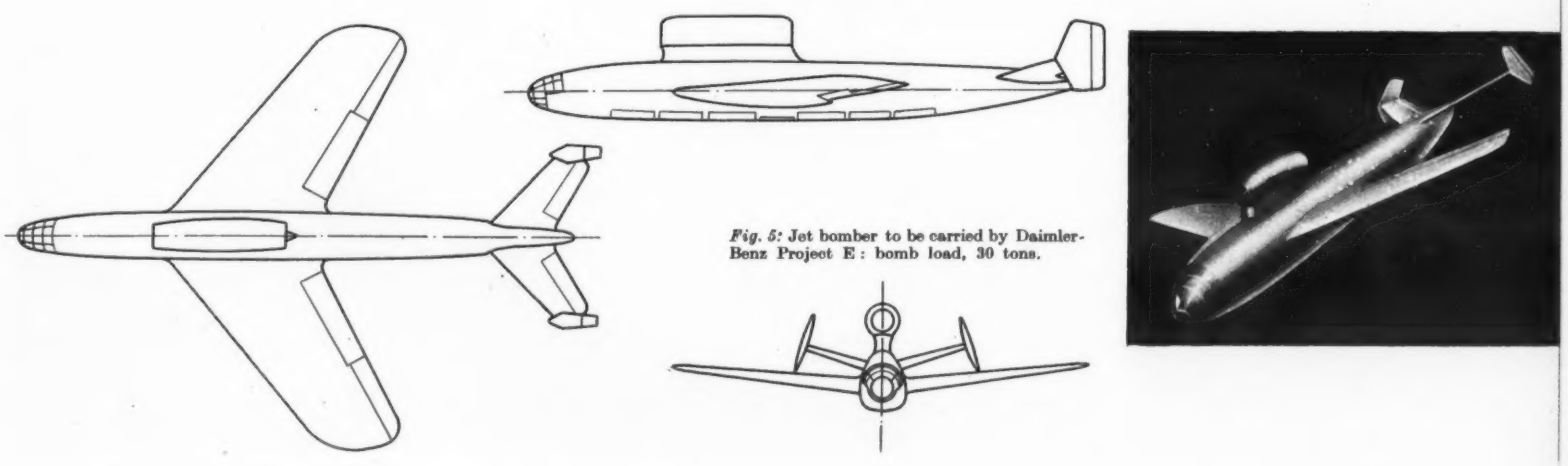
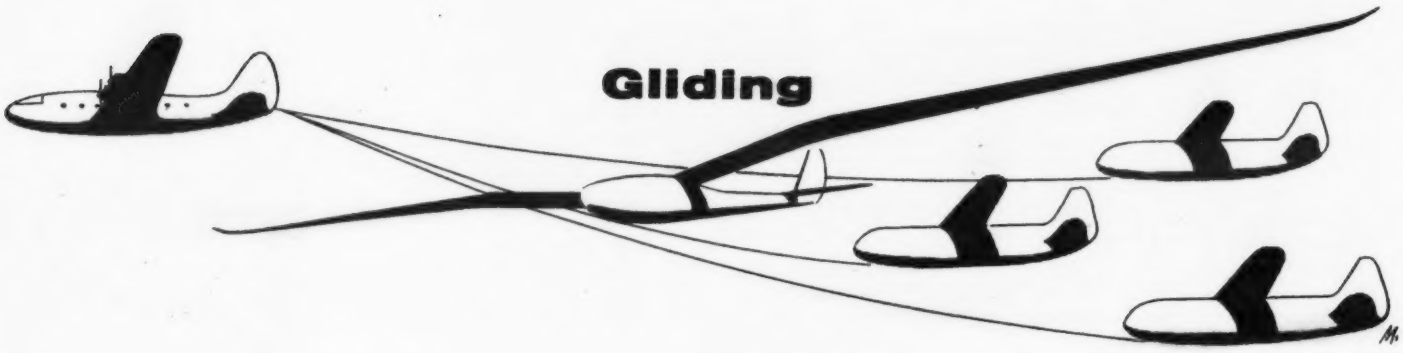


Fig. 5: Jet bomber to be carried by Daimler-Benz Project E: bomb load, 30 tons.



New Vistas in Sailplane Design

BY M. LANDOLF, LUCERNE

The performance factor in soaring flight.

The mention of a high-performance sailplane with a minimum sinking speed of 80 centimetres a second will cause many a soaring enthusiast to shake his head and tell you to stop pulling the wool over his eyes. And he will continue applying the term "high performance" solely to sailplanes with a sinking speed of at the most 60 to 50 cm./sec., and more likely 40 cm./sec., simultaneously having a gliding angle of at least 1 in 35, though if possible, between 1 in 40 and 1 in 50—even if these limits of performance can only be attained at very low and narrowly-restricted speeds and at the penalty of structural strength and manoeuvrability, or even if they are only blueprint data.

The fact that it is usually more important to have a good gliding angle than an extremely low sinking speed was already recognised in the early days of engineless flight, when simple hovering glides first began evolving into distance flights, and pilots had to learn the art of mastering headwinds and downcurrents. The advent of thermal flying notably gave rise to the desire for improved manoeuvrability ; and around 1930 Robert Kronfeld was the first to express a definite demand for good flying characteristics—a trend which was in all likelihood the fruit of early experiences in cloud flying with gliders, which amounts to the same thing as blind flying rendered considerably more difficult by the absence of an engine. Besides this, the advent of cloud flying was accompanied by a lusty call for much greater attention to the factor of structural strength ; and this is easily proved by the example of the 1937 Rhön competition in which one and the same thunder cloud reduced three gliders to matchwood.

The question today is whether these latest requirements, which fall better in line with the dynamic nature of soaring as a quest for atmospheric sources of energy, especially when flying in the Alps, than dazzling static performance data, have found their way sufficiently far into the design principles.

Some years ago a Swiss firm asked prominent glider pilots to state the qualities they would like to find in an efficient sailplane. True, a wide diversity of opinion showed many of their demands to be incompatible ; astonishing unanimity, however, was manifested in connection with one fundamental principle pointing towards the following objectives :

increased structural strength for flying in clouds and other zones where strong gusts prevail (as is known, only very few types of gliders are certificated for cloud flying) ;

improved stability, particularly during banking positions when circling on instruments ;

flatter gliding angle at higher speed (for distance flights).

These experts expressed a common desire for a higher degree of manoeuvrability in the turn, which should enable a pilot circling on a thermal, to remain nearer the core of upcurrents, where lift is strongest, and also to derive fuller benefit from slope lift by hugging hillsides more closely. Their opinion was that resultant gains in altitude would greatly outweigh the increase in minimum sinking speed.

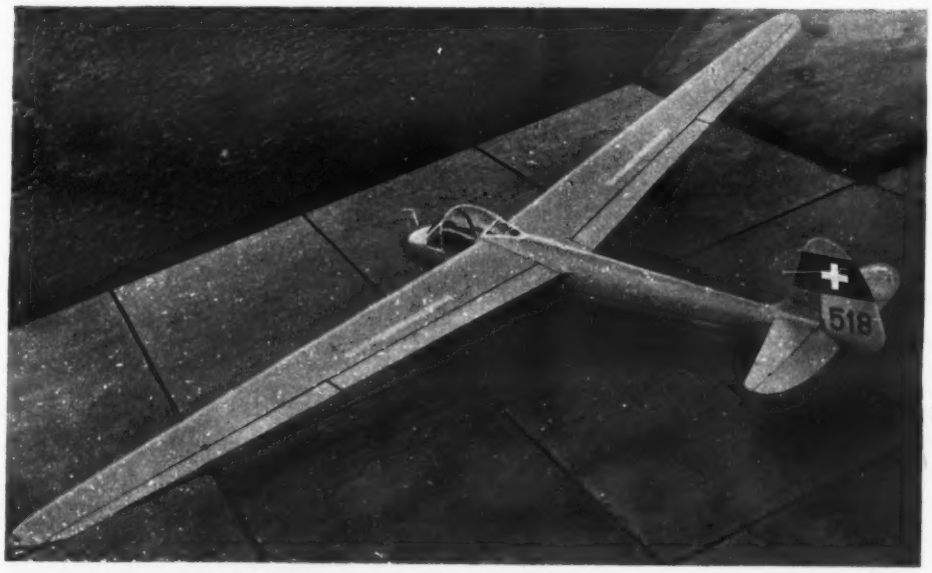
Front view of the WLM-1. Note the thin wing section and moderate span.

The aeroplane as example.

Judging by the undoubtedly higher standards of controllability and stability attained in aeroplanes, it would appear that sailplane designers have pursued their efforts towards achieving high-performance types rather one-sidedly. It was not without purpose that this magazine* called to mind the very surprising fact that, while the old controversy about the value of gliding as an instructional method prior to military and transport flying is still going on, no one has so far developed a suitable training glider. Meanwhile, the description below of the new *WLM-1* sailplane may serve to show that this reproach is not altogether justified.

*Cf. "Interavia, Review of World Aviation" Vol. II, No. 12, P. 57.

WLM-1 high-performance single-seater sailplane.



The opinion that gliding gives pupils many misleading impressions on powered flying is still frequently to be heard from flying instructors. One or two aeroplane pilots, perhaps somewhat pampered, go so far as to maintain that many types of sailplane are insufficiently stable at low airspeeds and therefore, at least under rather turbulent conditions of atmosphere, precisely the range of their high performance becomes practically illusory.

If a harmonious transition from one type to the other is to be achieved, then an effort must be made to have the sailplane resemble the aeroplane. This resemblance must also embrace the controls, in which connection there is an urge not only for improved controllability, but also for more ways of actuating the controls. Finally, it is easy to see that something will have to be done about the present austere cockpit layouts of sailplanes if soaring is to capture the enthusiasm of aeroplane flying instructors used to comfortable cabins.

The WLM-1 single-seater sailplane.

The answers to the questionnaire mentioned above were used by the firm of Weber-Landolf-München (WLM), aeronautical engineers, Lucerne, to compile the specification book of their first sailplane, the *WLM-1*. By complying to a great extent with all the requirements listed earlier on, this firm was able to build an aircraft offering a very wide range of applications. Apart from making it fully aerobatic, exceptionally *great resistance to gusts*, which was aimed at with the object of achieving a reliable degree of airworthiness for cloud flying, also gives it a high maximum permissible flying speed and towing speed. The demand for *favourable L/D conditions with a wide speed range* was met by a variable-camber wing (a solution frequently attempted, though never consistently pursued in conjunction with high-speed wing sections and great structural strength). The utilisation of camber flaps amounts to the same thing as combining various aircraft characteristics and, in a miniature way, brings to mind the great adaptability of birds' wings.

As is known, the typical sailplane wing sections feature considerable camber. As the sketch below shows, these wing sections give good results at low speeds, but at fast speeds suffer from high drag and consequently low rate of sink.

The split camber flaps chosen for the WLM-1 extend to 24 per cent. chord and can be made to travel through 40 deg. by means of a handwheel. Initially, the ailerons extend with them, through almost 20 deg. The main assignment of the flaps is not to assist landings, but to adapt the aircraft to up-current conditions and to the attitude of flight : fast flying with flaps up to overcome unfavourable stretches with a minimum loss of altitude and time ; normal gliding with flaps very slightly down ; tightest curves with flaps down 20 deg. and more ; landing with flaps right down, at the same speed as less heavily-loaded sailplanes. A relatively thin wing section coupled with high wing loading and a small span also helps to improve the high-speed characteristics. Finally, the feeble camber with flaps up provides properties for inverted flight, including outside loops, etc., rarely found in sailplanes.

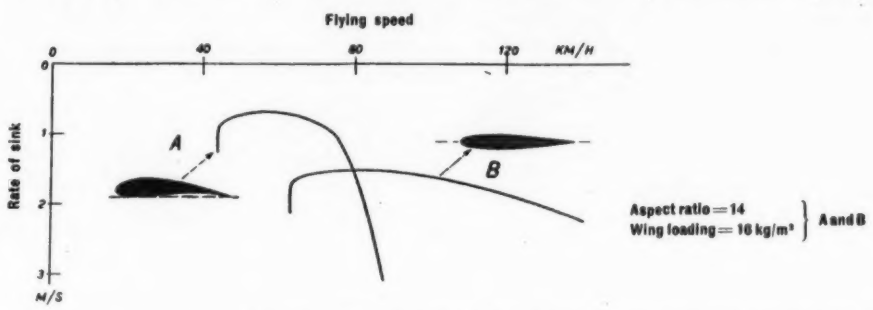
A few days after its completion, the prototype *WLM-1* set up a Swiss national altitude record — July 30th, 1947 : 4,120 metres (13,520 ft.) gained above starting point — and was shortly afterwards placed second in the First International Gliding Week at Samaden, Switzerland. In January, 1948, after six month's testing, the prototype was fully certificated by the Federal Air Office. In view of its high limiting speed, the type-certification tests were made to include a thorough investigation of the flutter characteristics, by both calculation and flight tests. In these, speeds of over 340 km./hr. (210 m.p.h). were flown, and the machine put into a limit dive with air brakes extended, with 250 km./hr. (155 m.p.h.) as max. reading.

Construction.

Wing : Cantilever, mid-set, with marked upward dihedral. NACA 23013 centre-section and NACA 23007 tip. Two spars ; plywood skin laid diagonally as far as rear spar, remaining rear part fabric-covered. Plywood skin, as on fuselage and empennage, entirely covered with fabric (resistance to weather). Light-alloy dive brakes, located between rear spar and camber flaps, extend above and below the wing and work in opposite directions to balance the actuating loads (as in the DFS system). The wing is formed of two easily-dismantled parts and is connected by three bolts to the fuselage ; a fourth bolt joins the upper flanges of the front spar of both wing-halves. .

Fuselage and Empennage : Plywood semi-monocoque with fabric covering. Detachable metal nose portion. Large fuselage diameter —outside measurements : 64 cms. (2 ft. 1 in.) wide and 110 cms. (3 ft. 4½ in.) high ; roomy cockpit, easy entry and exit.

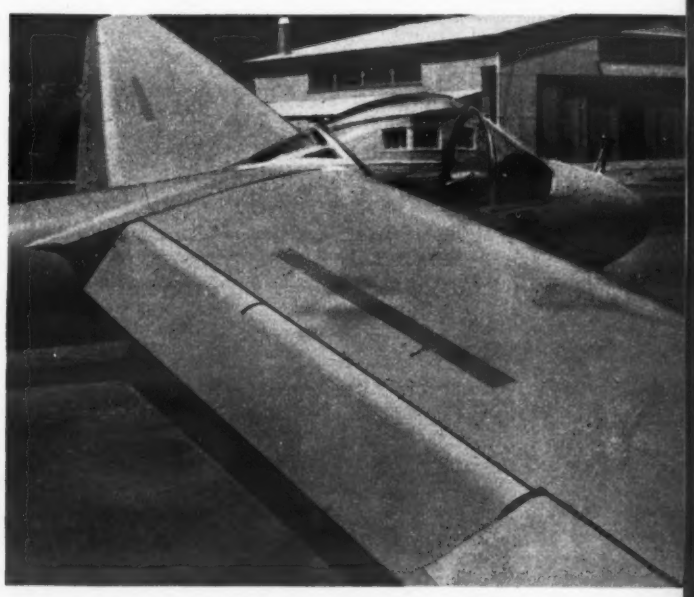
Empennage of wooden-framework with ply-covered fixed surfaces and fabric-covered

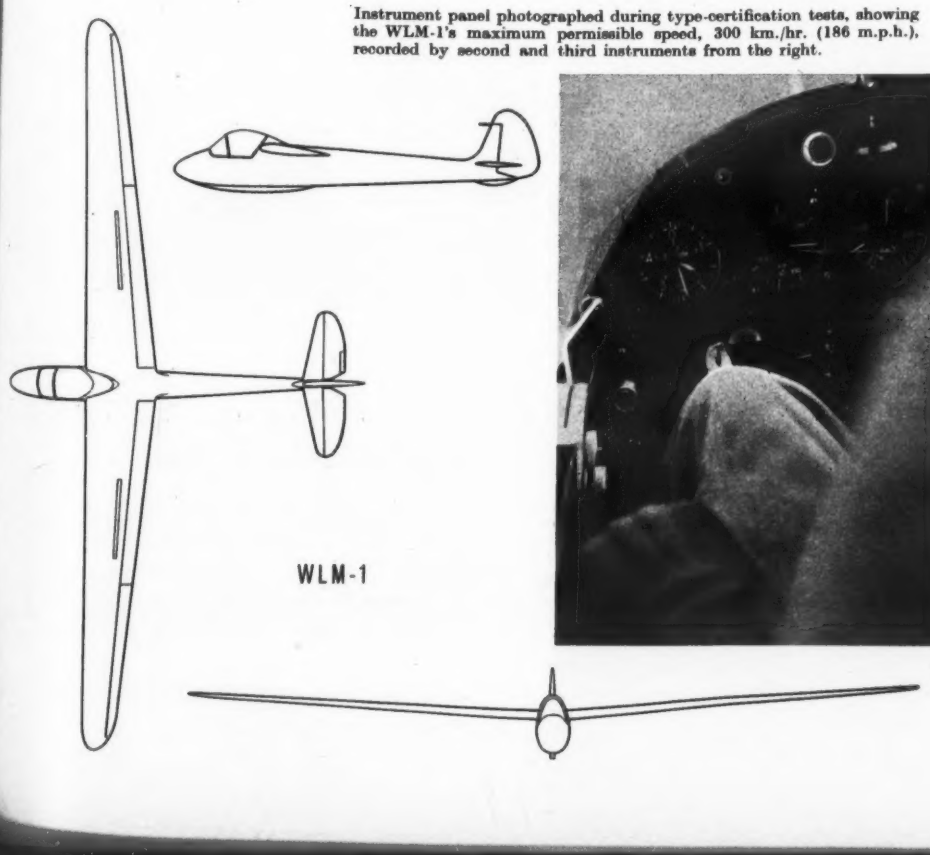


Influence of camber : section A highly cambered, section B flat. Otherwise same wing and same wing loading.

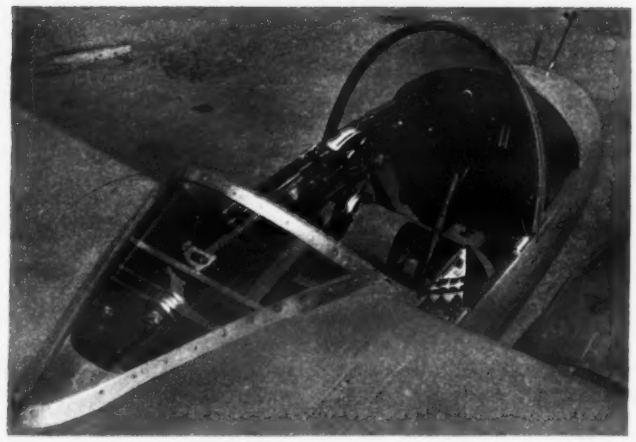
Instrument panel photographed during type-certification tests, showing the WLM-1's maximum permissible speed, 300 km./hr. (186 m.p.h.), recorded by second and third instruments from the right.

When the split camber flaps are extended, the ailerons travel with them through up to 20 deg.

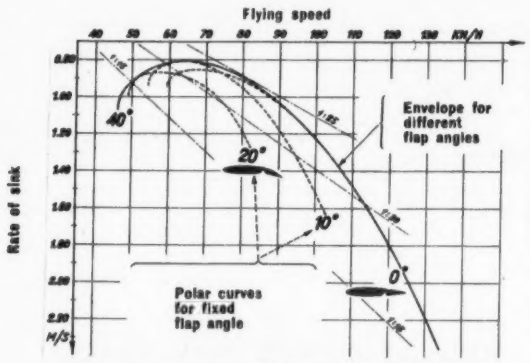




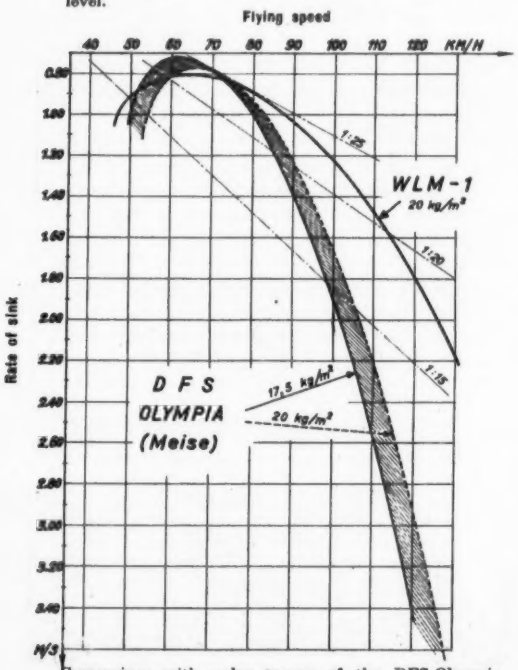
Starboard dive brake visible aft of the full-view cockpit hood.



The WLM-1 was designed as a training sailplane for primary flying instruction, and its instrumentation greatly resembles that of an aeroplane.



WLM-1's polar curve: 20 kg./m² (4.09 lb./sq. ft.), sea-level.



Comparison with polar curves of the DFS-Olympia "Meise": curve for 17.5 kg./m² (3.58 lb./sq. ft.) plotted from official flight data; 20 kg./m² (4.09 lb./sq. ft.) curve from data calculated on basis of these.

movable surfaces. Elevator with trimming tab; elevator unit folds upwards on both sides.

Controls: Inside the wing for flaps and ailerons, actuated by rods throughout; wires inside the fuselage. Trimming tabs and dive brakes worked by levers in the cockpit, located on port side; handwheel for camber flaps. Rudder pedals adjustable in flight.

Characteristics:

Span	14.0 m. (45 ft. 11¼ in.)
Length	7.0 m. (22 ft. 11¾ in.)
Wing area	14.0 m² (150.7 sq. ft.)
Aspect ratio	14.0
Tare weight	195 kgs. (430 lbs.)
Disposable load ..	85-115 kgs. (185-255 lbs.)
Gross weight	280-310 kgs. (615-685 lbs.)
Wing loading	20-22 kg./m² (4.09-4.51 lbs./sq. ft.)

Performance:

[280 kgs. (615 lbs.) all-up, 20 kg./m² (4.09 lb./sq. ft.) wing loading, sea-level]:-

Best L/D ratio, 1 : 25 at 82 km./hr. (51 m.p.h.) —flaps down 4-5 deg.;

Min. sinking speed, 0.80 m./sec. at 66 km./hr. (41 m.p.h.)—flaps down 8-10 deg.;

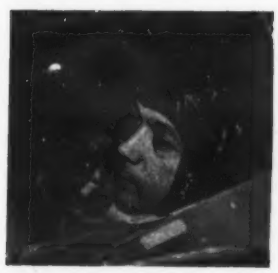
Stalling speed 47 km./hr. (29 m. p. h.)—flaps down approx. 40 deg.

Further performance data can be derived from the accompanying polar curves (rate of sink versus flying speed). Comparison with the polar curve for the well-known Olympia "Meise" single-seater sailplane of the DFS (Deutsche Forschungsanstalt für Segelflug) shows how the utilisation of a high-speed wing section with flaps extends the useful range and, in particular, improves the L/D conditions at high airspeeds. The data for the *WLM-1* are calculated figures which have so far been checked on only a few points by measurement.

The conditions attached to the type-certificate delivered by the Federal Air Office last January indicate that the WLM-1, at its maximum gross weight of 310 kgs. (685 lbs.), is sufficiently sturdy to allow for every kind of take-off, aerobatics and aerobatic instruction, cloud flying, blind flying and instrument instruction. At the maximum speed of 300 km./hr. (186 m.p.h.) it can stand a + 5 g pull-out and a — 1.8 g nose-down; at 160 km./hr. (99 m.p.h.) a nose-down of — 3.0 g is still within the permissible stress limits.

Aeroplane pilots have expressed satisfaction with the new sailplane's normal and aerobatic handling characteristics. Besides showing it to have reached the standards of a good aeroplane as regards stability and controllability, the flight tests also revealed a great deal of similarity to the visibility and landing conditions common to jet aircraft with cockpit far forward and nose-wheel undercarriage. In view of its sturdiness and manoeuvrability, the *WLM-1* could be said to represent the first sailplane so far developed, which meets the requirements for instructing and converting military airmen.

WLM-1 high-performance sailplane being aero-towed for start. Undercarriage has been jettisoned.



Robert Kronfeld

In the December, 1947, issue of "Interavia Review" we introduced to our readers Squadron Leader Robert Kronfeld, A.F.C., A.F.R.Ae.S., *the well-known soaring ace, born in Vienna in 1904. He was to be the Contributing Editor of our new regular feature on gliding. The article which he wrote in that number, under the title "Gliding Today," was the last-but-one publication on this subject from his own pen.*

On 12th February, 1948, Kronfeld and one observer were testing a General Aircraft tailless research glider (GAL-56) near Lasham, Alton, Hants. They had just been released from their tug at about 17,000 feet when the aircraft seems to have gone into a spin. It recovered but then, for some unknown reason, nose-dived, turned on its back and crashed out of control. Kronfeld had jettisoned the hood and his observer was able to bail out. He himself was evidently unable to leave the aircraft.

A school friend describes Kronfeld as a reserved, lonely person. Only once did he see him full of enthusiasm—when the two schoolboys attended their first gliding meeting at Bisamberg, near Vienna. Kronfeld could hardly be induced to leave the field, and was entirely devoted to gliding after that day.

In the last paragraph of his article he wrote: "Gliding has, as can be seen, outgrown the sports stage." It is not too much to say that this was largely due to Robert Kronfeld himself. We take leave of an old friend and a contributor whose place will be difficult to fill.

The Editor.

THE MONTH IN REVIEW

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AIR POLITICS

● Civil Aviation Agreements have been concluded between the following countries : Norway and Czechoslovakia ; Italy and the United States, in Rome on February 6th ; Bulgaria and Czechoslovakia, in Sofia on January 22nd ; Austria and Holland, on January 22nd ; Canada and the Bahamas ; Great Britain and the Philippines ; and Great Britain and Peru, on December 22nd.

NEW AIRCRAFT

● The prototype of the *Short "Sealand"* twin-engined 5- to 8-seater amphibian executive transport made its first flight from Short Bros. & Harland Ltd.'s base at Belfast on January 22nd.

● The prototype of the Australian-built *de Havilland DHA-3 "Drover"* three-engined transport took to the air on January 23rd and has now started its flight test programme.

● On January 28th the first of three *Boeing YC-97A "Stratofreighter"* transports for the USAF's Air Transport Command made its first flight from Boeing Airplane Company's factory airfield, at Seattle, Wash.

First flight of Boeing YC-97A "Stratofreighter."

● Società Aeroplani Caproni, of Milan-Taliedo, are building a two-seater trainer, the *Caproni "Cator 111,"* of which the development was started in May of last year. It is a low-wing wooden monoplane with single fin and rudder unit and fixed conventional undercarriage. — Powered by a 130-H.P. Alfa Romeo 110bis air-cooled four-cylinder in-line engine driving a fixed two-blade airscrew, the "Cator 110" is expected to attain a maximum speed of 155 m.p.h.

● *S.A. Belge des Avions Fairey et Tipsy* have built a new two-seater trainer which is essentially a development of the firm's pre-war Tipsy M "Trainer." It is a low-wing monoplane of composite construction with two side-by-side seats enclosed by a transparent canopy ; single fin and rudder and fixed tail-wheel landing gear. The aircraft may be powered either by a 145-H.P. "Gipsy Major X" air-cooled four-cylinder in-line engine or by a more powerful "Cirrus Major III," of similar type, developing 155 H.P.

● *Aeronautica Industrial S.A. (AISA),* the Spanish aircraft firm, has developed a glider, primarily intended for training purposes, known as the *I.P.-2.* The contract was awarded by Iberavia S.A. When it has reached a more advanced stage of development, the I.P.-2 may also be built in a powered version.

Aeronautica Industrial S. A. : IP-2 glider.

● *"Utka"* (Duck) is the name given to a new canard-type aircraft designed by *Mikoyan and Guryevitch,* the Russian aeronautical engineers. It is a high-wing monoplane with pusher airscrew, and has a stubby cabin-fuselage. Two struts brace the mainplane which, located aft of the centre-point of the fuselage, features a constant chord and a marked degree of sweepback. The horizontal stabilising unit, with two elevators, is at the nose-end of the fuselage ; two fin and rudder units are located on the wing. The mainplane has normal ailerons, located outboard of the fins, and features a slotted leading-edge section in the vicinity of the ailerons. The tricycle undercarriage is not retractable. Power plant consists of an M 11 air-cooled five-cylinder radial rated at 115 H.P. for take-off.

● Grumman Aircraft Engineering Corp. has a new jet fighter project under development, the *Grumman XF10F-1.*

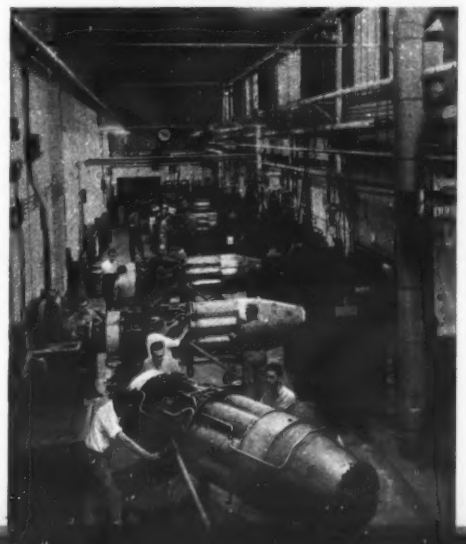
POWER PLANTS

● *The de Havilland Engine Co., Ltd.,* is developing a small airscrew-turbine of 500 H.P., designated *H. 3. The Bristol Aeroplane Co., Ltd.,* is also building a new airscrew-turbine, known as the *Bristol "Janus."* Both power plants are scheduled to be service-tested during the course of the year.

● *SNECMA,* the nationalised French aero-engine manufacturing concern, is developing a 36-cylinder engine of 5,000 H.P., for which no designation has yet been given. The *SNECMA 14 N 63* and the *SNECMA 14 R 1000* air-cooled 14-cylinder radials are the latest developments of the SNECMA 14 R and SNECMA 14 N 54, respectively. For take-off, the 14 N 68 develops 1,150 H.P. and the 14 R 1000, 2,200 H.P., the first-mentioned engine being rated at 900 H.P. SNECMA are also testing a new turbo-jet unit designated *ATAR 101 ;* so far a thrust of 3,750 lbs. has been recorded, but it is expected that the figure will be stepped up to 4,630 lbs.

● *General Electric Co.'s Aircraft Gas Turbine Division* will shortly stop production of the General Electric TG-180 turbo-jet in favour of a new gas-turbine unit.

Line-assembly of General Electric TG-180 turbo-jets.



Production of the remaining TG-180 engines for the USAF will be undertaken by the Allison Division of General Motors Corp.

INDUSTRY NEWS

● *Fairchild Aircraft Ltd.,* of Longueil, Quebec, are said to have decided to go out of business and to have already started negotiating with various interests concerning the disposal of their facilities. The *Fairchild F-11 "Husky"* light transport, the prototype of which has already been flight tested, may be taken over and produced by the Nickel Belt Airways Ltd., of Sudbury, Ont., according to reports from Toronto.

● The first *"Convair-Liner"* for American Airlines was flown from Consolidated Vultee Aircraft Corp.'s plant to A.A.'s base at Ardmore, Okla, on January 25th. It should be noted that the aircraft has only been given a test licence by the Civil Aeronautics Administration, and will be used solely for initial familiarisation by A.A. crews.

● The *SE 2010-01* four-engined commercial transport is nearing completion at the SNCASE plant, Blagnac Airport, Toulouse. It is scheduled to start its flight-test programme next July.

● *Scandinavisk Aero Industri A/S,* of Copenhagen, the only aircraft factory in Denmark, is to cease manufacturing aircraft and confine its activities to reconditioning work. This decision is a result of the withdrawal from Aero Industri of F.L. Smith & Co., the cement group and the aircraft firm's main financial backers.

INDUSTRY PERSONALITIES

● *Robert H. Jewett,* formerly Chief of Preliminary Design, has been appointed *Chief Project Engineer (Pilotless Aircraft)* of *Boeing Airplane Co.*

AIR TRANSPORTATION

● Commercial aircraft may shortly be allowed to use military air bases in the Caribbean, acquired by the U.S.A. under the Anglo-American air base-destroyer deal of 1940. *Kindley Field,* Bermuda, a military base operated by the USAF under this arrangement, has been used by both British and American commercial aircraft for a long time.

● The Australian Government is carrying out a five-year programme for the *survey and exploration of Antarctica,* during which it is hoped to find landing fields which may ultimately be used for an alternate Empire trunk route between Great Britain, South Africa and Australia, in the event of the Middle East route being closed.

* Excerpts from Nos. 1411-1424 (13th January to February 12th, 1948) of "Interavia, International Correspondence on Aviation," an illustrated newsletter published thrice weekly in four language editions, English, French, Spanish and German.

● Denmark will set up twenty new *weather stations in Greenland* for the International Civil Aviation Organisation in 1948 and 1949. Information will be collected at the station at Angmagsalik and broadcasted to trans-Atlantic aircraft every three hours.

● Facilities are being set up on the Zambesi river, four miles above the Victoria Falls, in Northern Rhodesia, for a *marine air base* for B.O.A.C.'s projected flying-boat service from England to South Africa.

● The *IATA Interline Traffic Agreement*, standardising the handling of tickets and cargo shipments involving more than one company, will probably come into force on March 1st.

● The Canadian Government aims to operate four trans-Atlantic flights daily, transporting 160 of the "displaced persons" at present in British assembly camps, to Canada, in May.

● An *international parcel post scheme* evolved by the U.S. Postmaster General, with rates based on a cost of 75 cents per ton-mile, will probably come into force shortly after the beginning of March. Details were forwarded on February 2nd to 31 countries for approval.

● The first *special helicopter airport* has been built by the Landgraf Helicopter Co. at the company's plant adjacent to Los Angeles Central Airport. Helicopter traffic is separated from aeroplane operations at the airport under a plan already approved by the C.A.A. : helicopters fly in a small circuit inside and below the level of aeroplane traffic.

● On January 10th, KLM Royal Dutch Airlines made its *100th flight to South America*. On January 24th, the line completed its *250th trans-Atlantic flight* from Amsterdam to New York and on the same day its *500th post-war flight from Amsterdam to Batavia*. KLM has been flying its Amsterdam—Johannesburg service twice weekly with Lockheed "Constellations" since February 10th.

● Northwest Airlines aims to introduce *Boeing "Stratocruisers"* on to its North Pacific route to the Orient this summer.

● Civil aviation technical assistance missions are being sent to Colombia, Equador and Bolivia by the U.S. Civil Aeronautics Administration. Similar arrangements will probably be made with Uruguay, Venezuela and Chile.

● *Peruvian International Airways* has intensified its Santiago de Chile—Lima—Panama—Havana—Washington—New York service from three to four round flights weekly. The line's passenger and cargo business has shown a general increase.

● *Aerovias Guest S.A.*, a recently-formed Mexican airline, opened a service from Mexico City to Madrid on January 9th, with a Lockheed "Constellation." *Iberia*, the Spanish airline, is considering opening a reciprocal air service from Spain to Mexico with Douglas DC-4's.

● *Aerlinte Eireann Teoranta* will start its scheduled service from Dublin to New York with Lockheed "Constellations" on March 17th.

● *Trans World Airline* plans to open a weekly all-freight service between New York and Geneva with Douglas DC-4's on March 1st. This will supplement the existing weekly all-cargo service between New York and Bombay, via Europe and the Middle East.

● *C.S.A.*, the Czech airline, is reported to be planning to open a daily service with Lockheed "Constellations" from *Prague to New York and Chicago* in March or April. Services are to be operated in pool with *Pan American World Airways*.

● On February 1st *P.A.A.* intensified its service from New York to Calcutta, via Europe and the Near East, from two to three round flights weekly.

● The three leading Italian airlines, *Alitalia* (backed by B.E.A.), *LAI* (backed by T.W.A.) and *ALI* (belonging to the Fiat group) are reported to be contemplating combined group operations (after the pattern of Scandinavian Airlines System) on their international services. Italian sources consider that only two lines will be licensed to operate international services and only one for domestic services.

● In January *Alitalia* opened its first three international services : Rome—Paris, twice weekly with SIAI-Marchetti S.M. 95 four-engined transports ; Rome—Cairo, weekly ; and Rome—El Adem—Asmara, twice monthly with Avro "Lancastrian" and S.M. 95 transports.

● A number of airline companies, especially T.W.A., are reported to have informed the Italian authorities that they may have to cut out their intermediate landing at Rome, as *Ciampino Airport* is inadequate for current traffic volume. The airport is touched by 63 international routes and handles an average of 120 transports daily.

● *Air France* plans to have replaced all Douglas DC-3's on its European network by "Languedoc 161" four-engined transports by the Spring. At the beginning of February Air France opened a Bordeaux—Lisbon—Casablanca service. The former Paris—Lisbon—Casablanca service is thus rendered superfluous and the Paris—Lisbon leg is now flown as a new service.

● On February 2nd *Sabena* inaugurated a new twice-weekly service from Brussels to Lisbon, via Madrid, operated with Douglas DC-3's.

● The Polish three-year plan for economic reconstruction provides 150 million Zloty for the procurement of new commercial transports abroad. It is likely that these aircraft, for the nationalised LOT airline, will be bought entirely in France.

● At the end of February, *LOT* plans to open a new service to Scandinavia, from Gdynia to Oslo via Stettin—Copenhagen—Malmö—Gothenburg.

● *C.S.A.*, the Czech airline, plans to open the following international services during the year : Prague—Geneva—Nice—Algiers ; Prague—Helsinki ; Prague—Vienna—Trieste ; and Prague—Leipzig—Hamburg. The line is also considering starting services to India and South Africa.

● *British European Airways* is to be reorganised by April 1st, the start of the line's next financial year : the Headquarters, Continental and English Divisions, are to be merged, whilst the Scottish Division will remain separate. The reorganisation will involve reductions in staff.

● *B.O.A.C.* has intensified its Short "Sandringham" flying-boat service to Bahrein, Iran, from two to three round flights weekly. Bahrein is also touched by the twice-weekly service from England to Hong Kong with Short "Solent" flying-boats.

● *Qantas Empire Airways*, the Australian airline, expects that 13,000 seats will be available on the England—Australia services after June, 1948, when its "Constellations" will be joined by B.O.A.C.'s Short "Solents."

SERVICE AVIATION

● On March 1st the USAF's Air Transport Command (A.T.C.) and the Naval Air Transport Srevice (NATS) are to be merged as the *Military Air Transport Service*, under the control of the Air Force. The combined force is to be commanded by *Major-General Laurence S. Kuter*, with Rear Admiral John P. Whitney as Deputy Commander. *MATS* will open a round-the-world service.

● A Bill has been introduced in the U.S. Senate to spend $2,000,000,000 in each of the 1949 and 1950 fiscal years " to regain and maintain the supremacy of the United States in air power."

● *Defence Appropriations* of $10,295,000,000 make up over one quarter of President Truman's proposals for the total expenditure of $39,700,000,000 for the 1949 fiscal year beginning on July 1st, 1948. A sum totalling $767,000,000 is required for aircraft procurement, involving 2,325 aircraft. Procurement of guided missiles calls for $10,300,000, against the revised 1947/48 sum $13,000,000. The total research appropriation of $145,000,000 is only $316,00 less than that for 1947/48.

● *The Soviet Union's 1948 Budget* envisages a defence expenditure of 66,000,000,000 roubles, which is 17 per cent. of the total budget proposal. For transport, a sum of 13,800,000,000 roubles is proposed.

● *The Belgian 1948 Defence Budget* calls for a total of 4,344,473,375 frs., with 694,000,000 for the Air Force. The total budget proposals call for an expenditure of 56,800,000,000 frs.

● In the *Norwegian 1948-49 Budget*, 206,800,000 Norwegian crowns are proposed for defence, out of a total proposed expenditure of 2,268,000,000 crowns. This is 16,000,000 crowns more than in the current budget.

● *The Swedish Budget* proposal provides for an expenditure totalling 4,769,000,000 Swedish crowns, including 736,400,000 for defence, with 229,000,000 crowns for the Air Force.

● *The Spanish 1948 Defence Budget* gives the Air Ministry 1,119,000,000 pesetas ; this is the first time that the Air Arm receives more than the Navy (956,000,000 pesetas).

ERRATUM :

The advertisement for the Swedish *SAAB "Scandia"* twin-engined commercial transport, published on page 10 of "Interavia, Review of World Aviation," Vol III, No. 1 (January, 1948), gives this aircraft's range at economic cruising speed as 680 miles. The manufacturers, *Svenska Aeroplan A.B.*, have requested us to rectify this mistake. It should be noted that the "Scandia's" range at economic cruising speed is between 1,000 and 1,700 miles.

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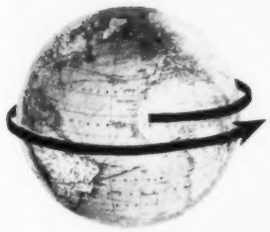

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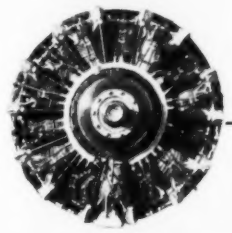

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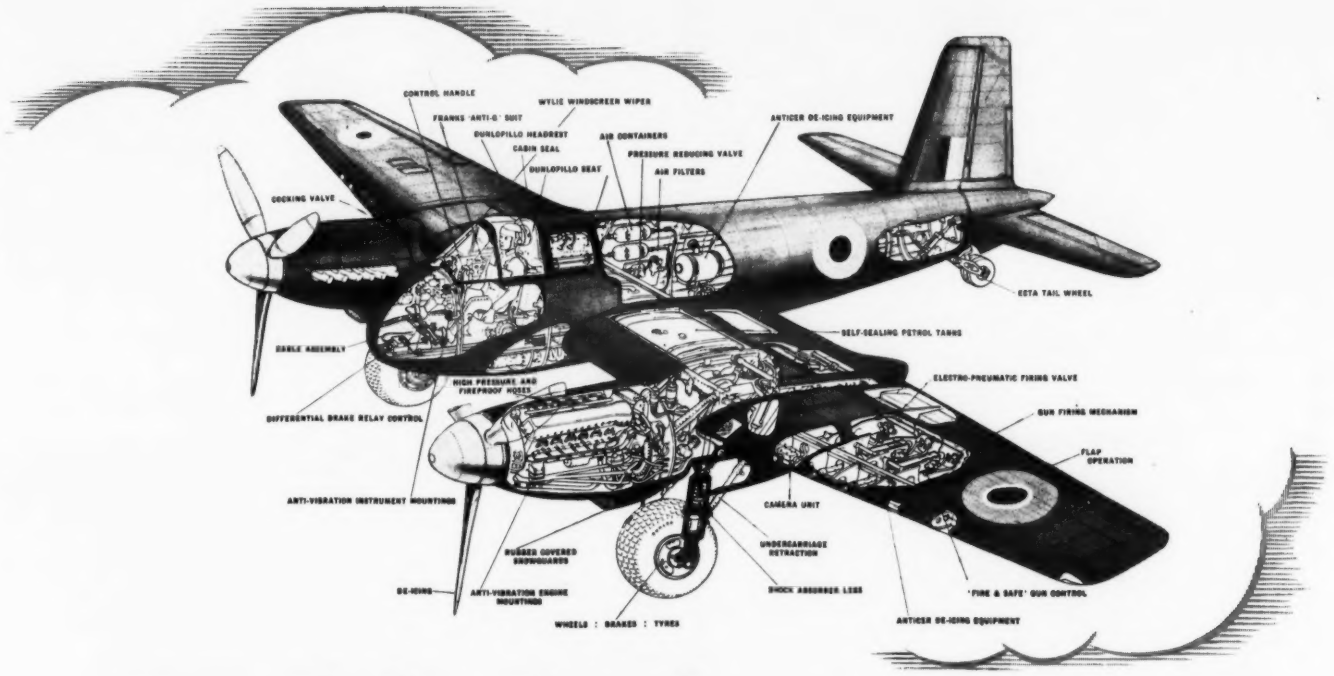

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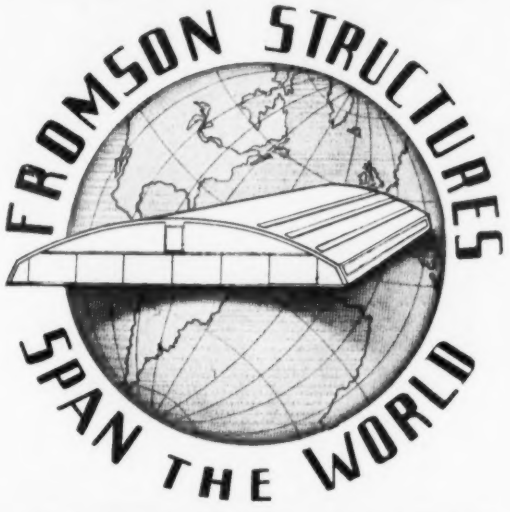

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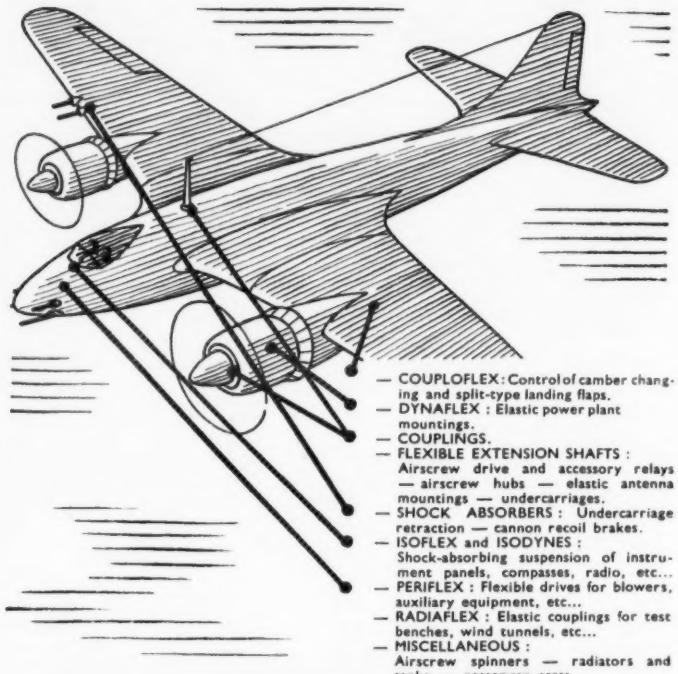

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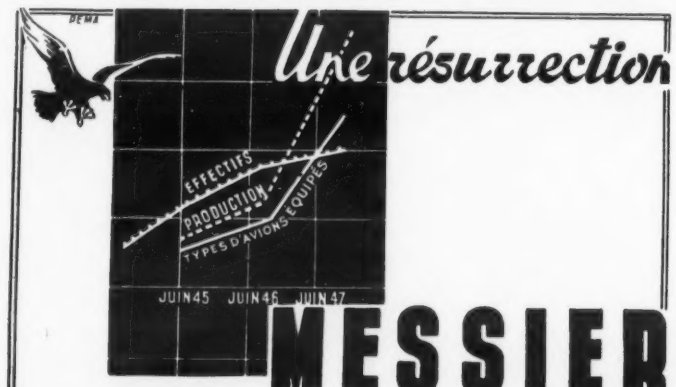

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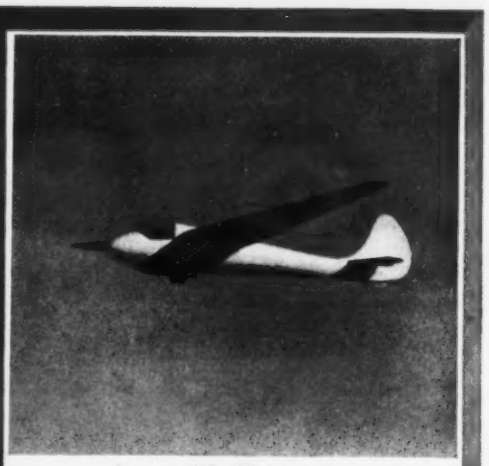

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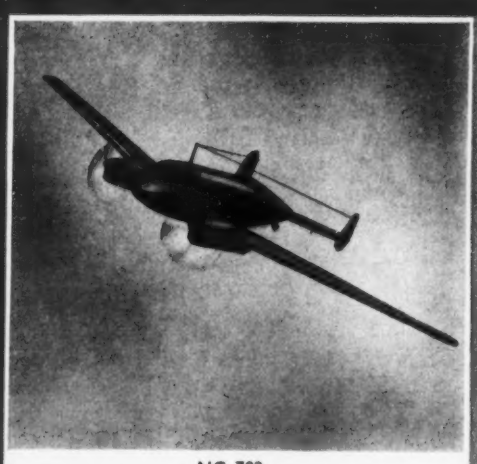

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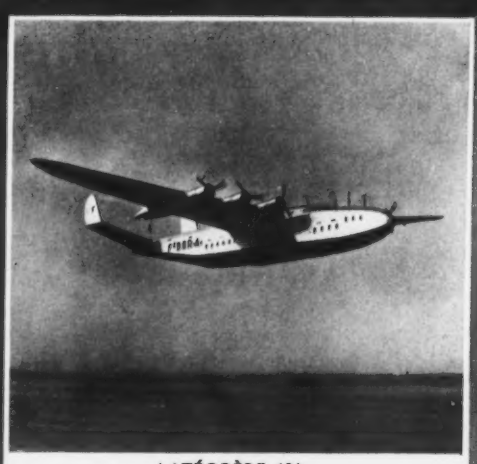

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